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Energy Research Abstracts

Abstracts 22649–25476

Office of Scientific and Technical Information
UNITED STATES DEPARTMENT OF ENERGY

The Office of Scientific and Technical Information

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The subject scope of this information extends beyond energy, covering basic scientific studies in such areas as radiology, atomic and nuclear physics, radiation and nuclear chemistry, superconductivity, supercomputers, the environment, radioactive waste management, nuclear medicine, and arms control.

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UNITED STATES DEPARTMENT OF ENERGY
Office of Scientific and Technical Information
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Energy Research Abstracts

Coverage

Energy Research Abstracts (ERA) provides abstracting and indexing coverage of all scientific and technical reports and patent applications originated by the U.S. Department of Energy, its laboratories, energy centers, and contractors, as well as theses and conference papers and proceedings issued by these organizations in report form. Audiovisual materials, computer media (magnetic tapes, diskettes, etc.), and engineering drawings are included in this definition. *ERA* also covers other energy information prepared *in report form* by federal and state government organizations, foreign governments, and domestic and foreign universities and research organizations, *provided* that the full text of the document has been received by OSTI. Foreign report information is obtained through the International Energy Agency's 14-nation Energy Technology Data Exchange, the International Atomic Energy Agency's International Nuclear Information System, or nation-to-nation agreements. The purpose of this publication is to announce documents produced or obtained by DOE that are not so readily available as journal articles, books, or patents.

Scope

The scope of *ERA* encompasses DOE's research, development, demonstration, and technology programs resulting from its broad charter for energy sources, supplies, safety, environmental impacts, and regulation.

The citations presented in *ERA* are available for online searching as records within the Energy Science and Technology Database (EDB). The current-year records are available on the Integrated Technical Information System (ITIS).

Availability

DOE and DOE contractors who have OSTI deposit accounts can obtain *ERA* (regular issues and annual indexes) from the Office of Scientific and Technical Information, P.O. Box 62, Oak Ridge, TN 37831, Attention: Information Services. For further information, call (615)576-8401. *ERA* is also available at authorized GPO Depository Libraries. (List is provided on the inside back cover.)

ERA (regular issues and annual indexes) is available to the public on a subscription basis from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

Managing Editor, Doris M. Henline
Technical Editor, Milton O. Whitson

Information Sources

The citations presented in *Energy Research Abstracts* are a subset of the worldwide energy information provided to the Office of Scientific and Technical Information (OSTI) through exchange agreements with foreign sources and through exchanges or contracts with U.S. organizations.

The **Energy Technology Data Exchange (ETDE)** was established by the International Energy Agency to promote cooperation among members in conducting appropriate energy-related research and development programs through the development of a formal central information sharing system. In accomplishing the objectives of the ETDE, members select, abstract, and index relevant research information published in their countries in accordance with Exchange standards. OSTI serves as the central receiving and processing center for this information, which it then disseminates to national centers in the participating countries. The following countries are currently members of the ETDE:

- Canada
- Denmark
- Finland
- France
- Federal Republic of Germany
- Italy
- Japan
- The Netherlands
- Norway
- Spain
- Sweden
- Switzerland
- United Kingdom
- United States

The **International Nuclear Information System (INIS)** was established to promote the exchange of information on nuclear science and technology. Its operation is similar to that of the ETDE, with the INIS Secretariat being located in Vienna, Austria. Currently, 79 countries and 15 international organizations are members of INIS. OSTI serves as the INIS national center for the United States.

In the exercise of its rights and responsibilities under the agreements to which it is a party, the **Office of Scientific and Technical Information** both receives information from the above sources and submits U.S.-produced information to them. In addition to materials generated by the Department of Energy, this U.S.-produced information is gathered from other government agencies as well as under contract with private information processing companies. All input is computer processed and entered into a database for online retrieval. The database serves as well for the production of numerous OSTI publications.

How To Read A Citation

The principal data elements included in these citations are:

1. **Abstract number** within volume.
2. **Report number** identification for report-type literature.
3. **Title and subtitle** (non-English title may appear in parentheses, if applicable).
4. **Author(s).** First 10 names in the data record are printed, then "et al." is listed.
5. **Author affiliation.** Only first one is listed, in parentheses after author(s) to which it applies.
6. **Collaboration,** if present.
7. **Corporate author(s)** identifying corporation responsible for document.
8. **Date of publication.** If not known, a processing date is in brackets.
9. **Number of pages** or page range. Prices are based on total pages unless special pricing applies.
10. **Language** of document if non-English.
11. **Monograph title** if citation is an analytic (part, chapter, or paper) of a larger monograph.
12. **Sponsoring organization.**
13. **Contract or grant number.**
14. **Secondary identifying number;** may be a conference number.
15. **Conference title, location, and date,** if applicable.
16. **Order number.** The "DE" order number may be used for ordering from NTIS or OSTI, as appropriate. The "TI" prefix is valid only at OSTI.
17. **Sources of availability** from which a copy of the document may be obtained; usually appear as abbreviations. (See information on following page.)
18. **Drop note** or explanatory statement.
19. **Abstract.**
20. **Subject descriptors.** Listed only if no abstract or only a brief statement is included.

Sample Citations

Report

18494 (DOE/ER/40438–T1) **[Development of a hydrogen and deuterium polarized gas target for application in storage rings]: Progress report.** Haeberli, W. Phys. VI collaboration. **Wisconsin Univ., Madison (USA). Dept. of Physics.** [1989]. 12p. Sponsored by DOE Energy Research. DOE Contract FG02-88ER40438. Order Number DE89007246. **Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.**

This paper briefly discusses the Wisconsin test facility for storage cells; results of target tests; the new UHV...

Report Analytic

18500 (INIS-SU—69, pp. 30-32) **Transition energies in Ne-like ions. Correlation effects.** Vainshtejn, L.A. AN SSSR, Moscow. Fizicheskij Inst. 1988. (In Russian). In *Experimental and theoretical physics. Collection.* Order Number DE89780060. Available from NTIS (US Sales Only), PC A03/MF A01; INIS.

Kratkie Soobshcheniya po Fizike.; no. 6.

SILVER IONS/energy-level transitions; XENON IONS/energy-level transitions; CORRELATIONS; D STATES; E STATES;...

54 (DOE/ER/60888-1-Vol.1, pp. 115-117) **Investigation of air pollution in house due to use of various fuels.** Luo, Dayu (Chengdu Sanitation (China)). Canada Mortgage and Housing Corp., Ottawa, ON (Canada). 1990. (CONF-900724-Vol.1: Indoor Air '90: 5th international conference on indoor air quality and climate, Toronto (Canada), 29 Jul - 3 aug 1990). In Indoor air '90: The fifth international conference on indoor air quality and climate. Volume 1: Final report. 786p. Order Number DE90017786. Source: NTIS.

Air pollution in houses caused by combustion of coal is more serious than that by combustion of natural gas and methane (primarily by SO_2 and NO_2). The gas concentration after cooking is higher than that before cooking, and it is higher in kitchen than in bedroom and outdoor. There were mutations in the extract from TSP in 30m^2 air in the bedroom, kitchen and outdoor, where coal and natural gas were used. The supernatant saliva activity of children whose family uses coal is significantly lower than that of pumping streams.

How To Order from the Availability Sources

TO OBTAIN A REPORT

Report literature, usually identified by an alphanumeric identifier at the beginning of a citation, is available from the sources listed in the citation (see example of element 2 on page iii). Often the sources are listed as abbreviations. Corresponding addresses are provided at right from which documents with these abbreviations may be ordered. When "OSTI" is given, **DOE and DOE contractors may order these documents from OSTI.** (However, check with your library or information organization which may require that orders go through them to OSTI.) OSTI prices are based on total pages unless special pricing applies. The public should order from NTIS or from one of the other agencies listed in the citation. NTIS price codes may continue to appear in some records. To expedite processing, an order form is provided in the back of this publication. NOTE: The order numbers provide quicker access for report ordering. Use the order number where possible.

GPO Superintendent of Documents
Government Printing Office
Washington, DC 20402

GPO Dep. Available for inspection or interlibrary loan at Government Printing Office regional depository libraries.

INIS *Available only in microfiche.*
INIS Clearinghouse
International Atomic Energy Agency
P.O. Box 100, A-1400
Vienna, Austria

NTIS U.S. Department of Commerce
National Technical Information Service
5285 Port Royal Road
Springfield, VA 22161

OSTI U.S. Department of Energy
Office of Scientific and Technical Information
P.O. Box 62
Oak Ridge, TN 37831

ESTSC Energy Science and Technology Software Center
P.O. Box 1020
Oak Ridge, TN 37831-1020

How To Use the Indexes

Five indexes are provided for approaching the content of each issue of *Energy Research Abstracts.* Descriptions of entries in these indexes follow.

Corporate Author Index
The corporation, organization, or institution responsible for the issuance of the document is listed in this index. The entries are arranged alphabetically and provide the title and citation number of the reference. For example, the listing for the "Report" sample citation would appear as shown at right.

Wisconsin Univ., Madison (USA). Dept. of Physics
[Development of a hydrogen and deuterium polarized gas target for application in storage rings]: Progress report, 15:18494 (R;US)
Wisconsin Univ., Madison (USA). Lab. of Genetics
Organization of the R chromosome region in maize: Final progress report, June 1, 1983–May 31, 1986, 15:18255 (R;US)

Personal Author Index
Each author's name listed on a document cited in this issue is indexed. An index entry provides title and citation number; for secondary and other names, a cross-reference is given to the primary author name where the full index entry is located.

Hadley, D.L., *See* Lee, A.D., 15:17651
Haeberli, W., [Development of a hydrogen and deuterium polarized gas target for application in storage rings]: Progress report, 15:18494 (R;US)

Subject Index
This index lists the main subject descriptors assigned to each record by indexing professionals. A secondary or qualifier term is used where necessary to describe materials, objects, and processes. Document titles may be enhanced with additional informative phrases where necessary. An excerpt from this index appears at right.

HYDROGEN ISOTOPES
See also DEUTERIUM
HYDROGEN 4
TRITIUM
Neutron-Rich Isotopes
Study on the strong neutron-rich nuclei of lightest elements, 15:18686 (RA;SU;In Russian)

Contract Number Index
DOE technical reports are listed by contract number. Each entry also provides the primary corporation or organization cited for that contract number. A typical entry is shown.

FG02-88ER40438 **Wisconsin Univ., Madison (USA). Dept. of Physics**
15:18494 DOE/ER/40438–T1
FG02-88ER60664 **Rogers and Associates Engineering Corp., Salt Lake City, UT (USA)**

Report Number Index
Technical report literature is indexed by the alphanumerical identifier of the report. Patent documents and conferences are included for convenience. Each entry lists the citation number, the source of availability of the document, an indicator of presence at a GPO depository library, order number, and distribution category. A typical entry is:

DOE/ER/40438– T1 15:18494 NTIS, OSTI E 1.99: DE89007246 MF-411

Subject Contents

The subject content of *Energy Research Abstracts* is arranged as shown below. The two-digit and four-digit category numbers printed here illustrate the category number assignment used in the database records.* The following list includes all of the 38 first-level and the 313 second-level categories. Because each issue of *ERA* publishes citations only for those documents announced during the past semimonthly period, some subject categories may not be present in every issue.

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*The numerical subject category scheme is used in the storage, retrieval, and manipulation of bibliographic information entered into DOE's data systems. Categories and definitions for the complete set of six-digit numbers are given in ETDE/PUB--1-R2, *International Energy: Subject Categories and Scope*.

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Energy Research Abstracts

01 COAL, LIGNITE, AND PEAT

22649 (KTM/E-B–122) **Finnish industry as users of IEA Coal Research Services.** Jyrkoenen, H. (Imatran Voima Oy, Vantaa (Finland)); Moring, K.; Partonen, S. Ministry of Trade and Industry, Helsinki (Finland). Energy Dept. 1993. 23p. (In Finnish). Project KTM-48/881/91. Order Number DE93794855. Source: OSTI; NTIS.

Imaran Voima Oy investigated, upon commission of the Ministry of Trade and Industry, the use of the services supplied by the IEA Coal Research, the usefulness of these services for Finnish firms and the extent to which Finnish firms would be interested in involved in the activities of the body and in funding its activities in Finland. Besides the cooperation in terms of the IEA Coal Research, the report covers any such other cooperation projects for the dissemination of energy research information in which the Ministry of Trade and Industry is involved. The majority of the firms consulted were aware of the operations of the IEA Coal Research and one-third of the firms had taken part in its seminars in Finland. The publications of the IEA Coal Research were found to be high standard and 70 % of the respondents felt that these publications current reviews had benefitted the operations of these firms. The same information can be obtained from other sources but not without extra efforts. Respondents valued the fact that the information in the reports is gathered in one place. The details supplied on Finland in the reports were mostly correct at the time of their publication though they had lost part of their currency by the time this survey was carried out in January 1992. In order to be constantly useful, the data bases should be updated frequently enough and be circulated to the users. The data bases would be even more helpful if they were available in magnetic form. For a Finnish user the reference data base is located in a wrong retrieval system. The same reference data are to be found in the ETDE Energy Data Base.

0103 Preparation

Refer also to citation(s) 22767, 24470

22650 (DOE/PC/89908–T29) **Engineering design and analysis of advanced physical fine coal cleaning technologies: Technical progress report No. 28.** Gallier, P.W. Aspen Technology, Inc., Cambridge, MA (United States). 20 Mar 1993. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-89PC89908. Order Number DE93014953. Source: OSTI; NTIS; GPO Dep.

Progress is identified in the following items reported as significant findings for the January 1993 reporting period: In Task 2, revisions to the dewatering topical report were started. In the Task 6 froth flotation work, Pittsburgh seam minus 28 mesh size and specific gravity analyses are complete, and analysis for the 100 mesh tests continued. Illinois No. 6 testing continues. In the Task 6 Coal Liberation work, ash analysis of 134 different composition/size fractions produced by the crushing of the 6M x 8M sample were completed.

22651 (DOE/PC/91290–T5) **Non-intrusive measurement of particle charge: Electrostatic dry coal cleaning: Technical progress report No. 6, October 1, 1992–December 31, 1992.** Kentucky Univ., Lexington, KY (United States). Center for Applied Energy Research. 1992. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-91PC91290. Order Number DE93014970. Source: OSTI; NTIS; GPO Dep.

Triboelectric charging/electrostatic separation experiments were performed using mineral pyrite, spherical silica, two coals and a carbon-silica spherical particle mixture. Two dimensional particle velocities in the separation chamber, as well as the number density distribution, were measured by a laser Phase Doppler Particle Analyzer (PDPA) for different tribocharging loop velocities (6–15 m/s). Particle deposition on the separation chamber's cathode and anode as well as the material passing through the separator were collected, weighed and analyzed to determine the separation efficiency. Typically, for a feed coal with 11 % ash, the coal recovery was around 70–95% with an ash content of about 4%. Deposits on the anode accounted for approximately 20% of the total feed weight and contained about 20% ash, while the cathodedepositions accounted for 70–90% of the total feed and contained less than 4% ash. Approximately 10–15% of the feed did not accumulate on either electrode and was collected at the bottom of the separation chamber. The net electric current induced in the copper charging loop when transporting coal particles (size range 38–45 microns) was much less than that for single component particles such as silica. This may bedue to a charge cancellation effect as a result of mineral matter and coal charging oppositely.

22652 (DOE/PC/92205–T2) **Bench-scale testing of the multi-gravity separator in combination with Microcel: Second Quarterly report, January 1, 1993–March 31, 1993.** Virginia Center for Coal and Minerals Processing, Blacksburg, VA (United States); Carpco, Inc. (United States); Roberts and Schaefer Co., Salt Lake City, UT (United States); Consolidated Coal Co., Library, PA (United States); Kerr-McGee Coal Corp., Oklahoma City, OK (United States). 30 Apr 1993. 53p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-92PC92205. Order Number DE93014972. Source: OSTI; NTIS; GPO Dep.

Work this quarter focused on the development of the engineering design specifications for the ET Test Circuit. Process flowsheets and detailed equipment specifications were finalized. Based on this information, bid packages were assembled and purchase orders were issued for all of the necessary process equipment. The design and procurement information is summarized in the ET Circuit Design Report submitted to the DOE's COR this quarter. Final drafts of the ET Circuit - System Safety Analysis, Nuclear Density Gauge - System Safety Analysis and Operating Manual/SOP were also completed and submitted to the COR this quarter. Preliminary characterization studies were also initiated this quarter. Tests were conducted to determine the grinding conditions required to achieve the desired particle size distributions for the characterization work. Flotation release analysis tests were conducted on both the Pittsburgh #8 and Illinois #6 seam coals as a function of grind size. The primary objective of the proposed work is to design, install, and operate an advanced fine coal processing circuit combining the Microcel and Multi-Gravity-Separator (MGS) technologies. Both of these processes have specific advantages as stand-alone units. For example, the Microcel column effectively removes ash-bearing mineral matter, while the MGS efficiently removes coal-pyrite composites. By combining both unit operations into a single processing circuit, synergistic advantages can be gained. As a result, this circuit arrangement has the potential to improve coal quality beyond that achieved using the individual technologies.

22653 (DOE/PC/92207–T1) **Bench-scale testing of on-line control of column flotation using a novel analyzer: Quarterly technical progress report, September 21, 1992–December 31, 1992.** Process Technology, Inc., Calumet, MI (United States). 22 Jan 1992. 55p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-92PC92207. Order Number DE93015051. Source: OSTI; NTIS; GPO Dep.

This document contains the first quarterly technical progress report for PTI's Bench-Scale Testing Project of a circuit integrating PTI's KEN-FLOTETM Column Flotation Technology and PTI's On-Line Quality Monitor Control System. The twelve-month project will involve installation of a 300 lb/hr. bench-scale testing circuit at PETC's Coal Preparation Process Research Facility (CPPRF) and testing of two bituminous coals (Upper Freeport and Pittsburgh No. 8 Seam Raw Coals). Figure 1 contains the project plan as well as the approach to completing the major tasks within the twelvemonth project. The project is broken down into three phases, which include: Phase I - Preparation: The preparation phase was performed principally at PTI's Calumet offices from October through

December, 1992. It involved building of the equipment and circuitry, as well as some preliminary design and equipment testing. Phase II - ET Circuit Installation and Testing: This installation and testing phase of the project will be performed at PETC's CPPRF from January through May, 1993, and will be the major focus of the project. It will involve testing of the continuous 300 lb/hr. circuit. Phase II - Project Finalization: The project finalization phase will occur from June through September, 1993, at PTI's Calumet offices and will involve finalizing analytical work and data evaluation, as well as final project reporting. This quarterly progress report principally summarizes the results from the Phase I preparation work and the plan for the early portions of the Phase 11 installation and commissioning, which will occur in January and the first week of February, 1993.

22654 (DOE/PC/92543–T2) **Micro-agglomerate flotation for deep cleaning of coal: Quarterly progress report, January 1–March 31, 1993.** Chander, S.; Hogg, R. Pennsylvania State Univ., University Park, PA (United States). Apr 1993. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-92PC92543. Order Number DE93014968. Source: OSTI; NTIS; GPO Dep.

We are investigating the use of a hybrid process, Micro-agglomerate flotation, which is a combination of oil-agglomeration and froth flotation. The basic concept is to use small quantities of oil to promote the formation of dense micro-agglomerates with minimal entrapment of water and mineral particles, and to use froth flotation to extract these micro-agglomerates from the water/dispersed-mineral phase. Since the floating units are agglomerates (about 30–50 μm in size) rather than individual coal particles (1–10 μm) the problems of froth overload and water/mineral carryover should be significantly alleviated.Micro-agglomerate flotation has considerable potential for the practical deep cleaning of coal on a commercial scale. In principle, it should be possible to achieve both high selectivity and high yield at reasonable cost. The process requires only conventional, off-the-shelf equipment and reagent usage (oil, surfactants, etc.) should be small. There are, however, complications. The process involves at least five phases: two or more solids (coal and mineral), two liquids (oil and water) and one gas (air). It is necessary to maintain precise control over the chemistry of the liquid phases in order to promote the interfacial reactions and interactions between phases necessary to ensure selectivity. Kinetics as well as thermodynamic factors may be critical in determining overall system response.

22655 (DOE/PC/92547–2) **Studies of incipient oxidation of coal-pyrite for improved pyrite rejection: Technical Progress report, January 1, 1993–March 31, 1993.** Yoon, R.H.; Richardson, P.E. Virginia Polytechnic Inst. and State Univ., Blacksburg, VA (United States). Dept. of Mining and Minerals Engineering. [1993]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-92PC92547. Order Number DE93014976. Source: OSTI; NTIS; GPO Dep.

To foster the development of advanced coal cleaning technologies, the initial stages of pyrite oxidation are being studied. The voltammetry behavior of polished pyrite at moderate overpotentials is known to be dominated by iron oxides and hydroxides that are generated during the polishing process. The present work is being done on pyrite surfaces that are freshly fractured in an electrolyte solution. The creation of fresh surfaces by in situ fracture allows studies of the initial oxidation of pyrite itself, without complications from overlayers of iron oxides and hydroxides produced by polishing. Chronoamperometry immediately after fracture and subsequent cyclic voltammetry is being used to elucidate the initial oxidation reaction that produces hydrophobic sulfur species on pyrite.

22656 (DOE/PC/92550–2) **Evaluation of hyperbaric filtration for fine coal dewatering: Second Quarterly technical progress report, December 1, 1992–February 28, 1993.** Parekh, B.K. (Kentucky Univ., Lexington, KY (United States)); Hogg, R.; Fonseca, A. Kentucky Univ., Lexington, KY (United States). 1993. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-92PC92550. Order Number DE93015063. Source: OSTI; NTIS; GPO Dep.

The normal practice in the coal preparation plant is to remove the water from the fine coal slurry by vacuum filtration and drying. Conventional vacuum filtration typically produces filter cake moisture containing in the range of 25 to 30 weight percent from minus 28 mesh coal slurries. Although the desired product quality can be obtained by using thermal dryers, there are problems associated with these equipment such as high capital costs and the greatest potential source of air pollution in a coal cleaning plant. In the present research project, an alternative to thermal drying, hyperbaric filtration which has shown potential in lowering moisture content in fine coal to about 20 percent level, is being investigated in detail. This project will essentially focus on developing fundamental information on particle-liquid interaction during hyperbaric filtration and applying the knowledge in developing optimum conditions for the pilot plant testing of the hyperbaric filter system.

22657 (ETDE-mf–93796884) **Flotation of coal < 20 μm in centrifugal force field.** Bothe, C. Technische Univ. Clausthal, Clausthal-Zellerfeld (Germany). Fakultaet fuer Bergbau, Huettenwesen und Maschinenwesen. 13 Aug 1992. 205p. (In German). Order Number DE93796884. Source: OSTI; NTIS (US Sales Only).

In this work a new type of flotation centrifuge was developed and examined in which the separation of the particle/bubble units from the slurry occurs in a transverse flow arrangement in the centrifugal force field. The slurry flows in a vertical conical full jacket centrifuge in a thin suspension film to the centrifuge outlet at which the bubbles rising at the film surface are separated from the slurry by an annular cutter. The deposition of the hydrophobic solid components is done in a special gasification reactor outside the centrifuge. This arrangement achieves large scale decoupling of the above flotation part process. The separation occurs in the centrifugal force field in calm flow. To examine the flotation process in the centrifuge, different hard coals with particle sizes smaller than 20 μm were used. (orig./HS).

22658 (OCDO–93013796) **A novel three phase fluidized bed process for simultaneous selective flocculation and microbial desulfurization of high sulfur coal: Final report.** Fan, Liang-Shih (Ohio State Univ., Columbus, OH (United States)); Bavarian, F.; Attia, Y.A.; Elzeky, M. Ohio Coal Development Office, Columbus, OH (United States); Ohio State Univ., Columbus, OH (United States). 16 Oct 1990. 152p. Sponsored by Ohio State Government, Columbus, OH (United States). Source: OSTI; Ohio Coal Development Office, 77 High Street, P.O. Box 1001, Columbus, OH 43266-0001 (United States).

The purpose of this work was to investigate the feasibility of recovery and reclamation of ultrafine coal particles generated during the processing of coal. 10–35% of the total annual tonnage of coal in atypical coal preparation plant is estimated to be lost in forms of ultrafine particles during the mining, shipping, handling, and preparation of the coal. The technical feasibility of the proposed system which consisted of an integrated circuit of selective flocculation followed by microbial desulfurization, has been tested. The results indicate that using selective flocculation/froth flotation circuit, coal recoveryis 85% with 75% pyritic sulfur and 60% ash rejections. The remaining pyritic sulfur in the coal slurry was treated using microbial desulfurization in a draft-tube fluidized bed bioreactor. Using this reactor scheme considerable enhancement of the bioleaching rate was obtained. The results indicate that 90% rejection of pyritic sulfur can be achieved in less than 24 hrs. Note that the previously reported data for the bioleaching rate are from 4 to 12 days for the same amount of pyritic rejection. The results obtained in this work closely reflects the anticipated outcomes which were projected in the original proposal. Consequently, the results of this work implies a significant improvement in bioleaching process and the possibility for the commercialization of the microbial desulfurization process. Our results also indicate further improvement of this process by optimization of reactor sequence and operating conditions.

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Refer also to citation(s) 22732, 22761, 22770, 22827, 23187, 23213, 23332, 23789, 23914, 24138

22659 (BNL–48737) **Catalytic reduction of carbon monoxide: Selective synthesis of C1 and higher oxygenates.** Mahajan, D.; Gupta, N. Brookhaven National Lab., Upton, NY

(United States). [1993]. 9p. Sponsored by USDOE, Washington, DC (United States); Electric Power Research Inst., Palo Alto, CA (United States). DOE Contract AC02-76CH00016. (CONF-930364–3: Spring national meeting of the American Institute of Chemical Engineers, Houston, TX (United States), 28 Mar - 1 apr 1993). Order Number DE93012528. Source: OSTI; NTIS; GPO Dep.

A-step synthesis of methyl formate, a C2 oxygenate, has been developed at BNL. The following features of the LLTMeOH technology and related studies are of interest: The BNL approach exemplifies a synergistic effect of two combined catalysts. The chosen reaction conditions favor methyl formate synthesis. The only identified by-product is methanol. The effect of stirring speed, temperature, solvent, catalyst loading, and syngas composition is noted.Of particular interest is a run with H_2CO = 37%/63% in which methyl formate selectivity approached 100%. Bases ($K_2CO_3KHCO_2$, $KOCO_2Me$) other than alkoxide have been used for methyl formate synthesis. A gas phase infrared mechanistic study of methanol carbonylation reaction, carried out with methoxide catalyst at 130°C under 1/1 (H_2CO) syngas, showed that the fast alkyl formate anion formations was followed by an extremely slow protonation step. It appears that under these conditions, protonation step is rate determining (RDS). This approach results in enhancing carbon conversion of syngas derived from coal or other sources that produce CO-rich gas.

22660 (CONF-891001–13) **Use of promoters to enhance hydrodenitrogenation and hydrodeoxygenation catalysis.** Hirschon, A.S.; Ackerman, L.L.; Laine, R.M.; Wilson, R.B. Jr. SRI International, Menlo Park, CA (United States). [1989]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-87PC79936 ;FG22-83PC60781 ;FG22-85PC80906. From 1989 international conference on coal science; Tokyo (Japan); 23-27 Oct 1989. Order Number DE93012937. Source: OSTI; NTIS; GPO Dep.

As the supply of cheap petroleum products diminishes, we will be increasingly dependent upon alternate feedstocks such as coal. Coal, and liquids produced from coal, are highly aromatic and contain much higher levels of heteroatoms such as nitrogen, sulfur, and oxygen than do petroleum based materials. These heteroatoms must be removed before the liquids can be upgraded into useful products. However, the current catalytic processes used to remove nitrogen and oxygen consume excessive amounts of hydrogen due to concurrent hydrogenation of aromatics. Most catalysts have been optimized for petroleum products and little work has been undertaken for the catalytic upgrading of coal based liquids. Catalysts that could economically promote cleavage of the heteroatom bonds while minimizing the hydrogenation reactions would greatly aid in making synthetic fuels a more attractive energy source. We have modeled C-N bond cleavage by examining homogeneous catalysis of the amine transalkylation reaction. The best catalysts for this reaction are ruthenium and osmium, while the metals used in conventional hydrotreating catalysis, nickel, cobalt, and molybdenum, are essentially inactive. From a study of bulk metal HDN studies we have found that ruthenium is one of the most reactive metals for C-N bond cleavage, although susceptible to sulfur poisoning However, by using this metal as a promoter with common hydrotreating catalysts such as NiMo, CoMo, and NiW, we have been able to prepare sulfur tolerant catalysts that exhibit high HDN activity, while at the same time undergoing minimal hydrogenation reactions. In this work we have compared several of these promoted catalysts for HDN and HDO reactivities as a function of composition, method of formation, and support.

22661 (CONF-891001–14) **Weak links and interfacial chemistry in coal.** Ross, D.S.; Hirschon, A.S.; Green, T.K. SRI International, Menlo Park, CA (United States). [1989]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-87PC79936. From 1989 international conference on coal science; Tokyo (Japan); 23-27 Oct 1989. Order Number DE93012936. Source: OSTI; NTIS; GPO Dep.

It has been estimated that the ultrafine mineral component in coal can be up to 15% of the total mineral content (ref 6), and the similarity of our results with coal to those for oil shale suggest that the reactive mineral/organic interfacial volume in coal could be substantial. While the mechanisms for reactions within the interphase are yet to be developed, our results suggest that attention be applied to this feature of coal in considerations of structure effects on both liquefaction and coal pyrolysis.

22662 (CONF-9207203–, pp. 75-79) **Non-covalent bonding in coal strucutre and novel applications.** Sanada, Y. (Hokkaido University, Sapporo (Japan). Faculty of Engineering). 22 Jul 1992. 320p. (In Japanese). From 1. meeting of The Japan Institute of Energy and the 70th Foundation anniversary meeting; Tokyo (Japan); 22-24 Jul 1992. In *Proceedings of the 1st Meeting of the Japan Institute of Energy and the 70th Foundation Anniversary Meeting.* Order Number DE93793523. Source: OSTI; NTIS (US Sales Only).

Study was made of non-covalent bonding in the coal structure and its applications to the coal-utilizing reaction. When absorbance measurement is made of electron spin resonance of coal to which iodine is added of a high electron-accepting power, the heightening in spin concentricity becomes large and the indicated interaction with iodine does strong with heightening in coalification rank of coal having a developed aromatic condensed ring structure. However in case of adding tetracyanoquinodimethane (TCNQ) which is of the same type of electron acceptor, the heightening in spin concentricity becomes large with lowering in coalification rank of coal. It is because the TCNQ has a strong interaction with the hydrogen bonding of low coalification rank coal. Knowledge of molecular association force can be obtained through adding the electron acceptor to the coal. Among the non-covalent bondings, the hydrogen bonding is important for the low coalification rank coal while for the high coalification rank coal, importance consists in cohesion by the interaction of electric charge's moving type and π-π interaction by the aromatic condensed ring structure. Proposal is made of many applications such as improvement in extractability by driving a molecular wedge like TCNQ's into the non-covalent bonding portion during the extraction of coal solvent and heightening in quick thermal decomposition tar yield by swelling with tetralin which is a solvent of hydrogen-donating type. 12 refs., 6 figs., 1 tab.

22663 (CONF-9207203–, pp. 82-85) **Active species in Zn-butyl iodide system for coal solubilization.** Yoneyama, Y. (Toyama University, Toyama (Japan). Faculty of Engineering); Gonda, K.; Mizutani, M.; Kato, T. 22 Jul 1992. 320p. (In Japanese). From 1. meeting of The Japan Institute of Energy and the 70th Foundation anniversary meeting; Tokyo (Japan); 22-24 Jul 1992. In *Proceedings of the 1st Meeting of the Japan Institute of Energy and the 70th Foundation Anniversary Meeting.* Order Number DE93793523. Source: OSTI; NTIS (US Sales Only).

Dibutylzinc (Bu2Zn) and butylzinc iodide (BuZnI) were synthesized to investigate solubilization effect of coal. The two kinds of butyl zinc compounds were synthesized using methods by Noller and Blaise et al. Coal butylation was carried out on Yubari coal using a predetermined amount of Bu2Zn and BuZnI under nitrogen atmosphere. When the Yubari coal was treated by BuI and supernatants in which BuZnI should be dissolved into Bu2Zn, butylated substances and benzen solubles were obtained at yields of 200% and 97% respectively, the result being the same as with a butyl iodide system. This fact clarified that the active species in the zinc-butyl iodide system are Bu2Zn, BuZnI and BuI. From a fact that the coal was solubilized very highly with the supernatant and BuI, the coal solubilization with Bu2Zn and BuI is defined that BuZnI is created during the reaction, and then dissolved into Bu2Zn to produce the supernatants. 5 refs., 3 figs., 2 tabs.

22664 (CONF-9207203–, pp. 92-95) **On the chemical structure of bituminous coals giving high extraction yields.** Takanohashi, T. (Tohoku University, Sendai (Japan). Institute for Chemical Reaction Science); Kaneko, H.; Iino, M. 22 Jul 1992. 320p. (In Japanese). From 1. meeting of The Japan Institute of Energy and the 70th Foundation anniversary meeting; Tokyo (Japan); 22-24 Jul 1992. In *Proceedings of the 1st Meeting of the Japan Institute of Energy and the 70th Foundation Anniversary Meeting.* Order Number DE93793523. Source: OSTI; NTIS (US Sales Only).

Researches have been made on structure of bituminous coals applying a solvent extraction process. The experiment consisted of CS2-NWP mixture solvent extraction, swelling measurement and size exclusion chromatography using macro molecular coal gel. Bituminous coals of 85 C% to 88 C% ranks such as the Zao Zhuang coal, China, are thought to have both extracts and residues formed

with macro molecular components. It is believed in a solvent extraction that the extracts are removed as a result of release of non-shared bonds betweeh coal molecules and large swelling of the coal because of solvent penetration, and that the remaining residues have a structure maintaining adequate cross-linking density according to the extraction factors. A column filled with pulverized extraction residues was connected to a liquid chromatography to investigate dissolution behavior of standard polystyrene test samples. It is seen that samples with molecular weights of about 10,000 or more are separated at an extraction factor of 25.6%, and those with molecular weights of about 1,000 or more at an extraction factor of 5.2%. However, further discussions are required when viewed from the size exclusion mechanism. 4 refs., 2 figs., 2 tabs.

22665 (CONF-9207203–, pp. 96-100) **Boiling point prediction of coal derived oil by group contribution method.** Sato, M. (Hokkaido University, Sapporo (Japan). Faculty of Engineering); Tanaka, A.; Yokoyama, S.; Sanada, Y. 22 Jul 1992. 320p. (In Japanese). From 1. meeting of The Japan Institute of Energy and the 70th Foundation anniversary meeting; Tokyo (Japan); 22-24 Jul 1992. In *Proceedings of the 1st Meeting of the Japan Institute of Energy and the 70th Foundation Anniversary Meeting.* Order Number DE93793523. Source: OSTI; NTIS (US Sales Only).

Boiling points of hetero compounds in coal derived oil were inferred using a group contribution method. From the relation between structural parameters for hetero compounds and their boiling points, effects of each structural parameter on the boiling points were considered, and a boiling point inference formula for hetero compounds was derived therefrom. Test samples of the coal derived oil are solvent fractions from Wandoan coal as a raw material. Hexane was used to sort out the fractions into hydrocarbon compound classes according to the number of aromatic rings, using HPLC. The fractions were classified into three hetero compounds while adding chloroform, and the compounds were analyzed for GC/MS, and their structures analyzed. The boiling point for the hetero compounds is the one for hydrocarbon being a skeleton structure of the hetero compounds given with consideration on its contribution to the boiling point of a characteristic atom group. Because δBH_{OH} (phenolic hydroxyl group of hetero compound as characteristic atom group) vary wholly depending on a displacement position of side-chain alkyl group, correlative coefficients obtained from a regression analysis are not very accurate. The relation between the chemical structure and the boiling points of the hetero compounds was made clear as had been done on hydrocarbons. 5 refs., 3 figs.

22666 (CONF-9207203–, pp. 111-114) **Effect of asphaltene in bitumen on co-processing of coal/bitumen.** Kondo, T. (National Institute for Resources and Environment, Tsukuba (Japan)); Matsumura, A.; Saito, I.; Ukegawa, K. 22 Jul 1992. 320p. (In Japanese). From 1. meeting of The Japan Institute of Energy and the 70th Foundation anniversary meeting; Tokyo (Japan); 22-24 Jul 1992. In *Proceedings of the 1st Meeting of the Japan Institute of Energy and the 70th Foundation Anniversary Meeting.* Order Number DE93793523. Source: OSTI; NTIS (US Sales Only).

Discussions were given on effects of asphaltene in bitumen during co-processing bitumen and coal on coal inversion rates, hydrogen consumption, and reactive products. Cold Lake tarsand bitumen was divided into asphaltene and de-asphaltene oil, then both components were mixed at a predetermined ratio to make bitumen with different asphaltene concentrations, and a mixed hydrogenation was conducted with Taiheiyo coal. It was made clear that the coal inversion rate can be maintained high by using oil-soluble MoDT with high dispersibility even if the asphaltene concentration is considerably high. However, TI and HI inversion rates decrease as the asphaltene concentration increased. Gas yield also increases, affecting the oil yield. Stability of the oil thus obtained is better with the less the asphaltene in the material bitumen, but would not have much of a problem even if the asphaltene concentration is as high as 50%. 3 figs., 2 tabs.

22667 (CONF-9207203–, pp. 115-118) **Coprocessing of coal with heavy oil over composite catalysts.** Miyake, M. (Osaka University, Osaka (Japan). Faculty of Engineering); Higashine, J.; Kido, A.; Nomura, M. 22 Jul 1992. 320p. (In Japanese). From 1. meeting of The Japan Institute of Energy and the 70th Foundation anniversary meeting; Tokyo (Japan); 22-24 Jul 1992. In *Proceedings of the 1st Meeting of the Japan Institute of Energy and the 70th Foundation Anniversary Meeting.* Order Number DE93793523. Source: OSTI; NTIS (US Sales Only).

With an objective to develop catalyst systems most suitable for coprocessing reaction, discussions were given on using coal and heavy oil having largely different properties in combination with catalysts thought to have functions suitable for making the coal and heavy oil lighter in gravity. The catalysts used were molten salts of multi component metal chlorides developed for coal liquefaction, compounded with Ni-Mo/Al2O3 for reducing gravity of the heavy oil. The coal samples were Wandowan coal and Akabira coal, and the heavy oil sample was Athabasca oil sand bitumen (AOB). Using NiCl2-LiCl-KCl catalyst simultaneously with the Ni-Mo/Al2O catalyst suppressed gas generation, and provided a highest Hs and a lowest BI, wherein composite catalytic effect emerged. Presence of an Ni-Mo/Al2O3 catalyst having high hydrogenation activity hydrogenates effectively fragment radicals of the coals decomposed by the molten salt catalyst and stabilizes the products. These should have resulted in increasing the HS yield and decreasing the BI and gas yield. 3 refs., 5 figs., 2 tabs.

22668 (CONF-9207203–, pp. 119-122) **Separate coprocessing of coal and oil.** Fujimoto, K. (The University of Tokyo, Tokyo (Japan). Faculty of Engineering); Aimoto, K.; Asano, T.; Nozaki, T. 22 Jul 1992. 320p. (In Japanese). From 1. meeting of The Japan Institute of Energy and the 70th Foundation anniversary meeting; Tokyo (Japan); 22-24 Jul 1992. In *Proceedings of the 1st Meeting of the Japan Institute of Energy and the 70th Foundation Anniversary Meeting.* Order Number DE93793523. Source: OSTI; NTIS (US Sales Only).

A hydrogen transfer pyrolytic process is proposed as a process to obtain decomposed product oil that consumes little hydrogen and has good properties from such heavy gravity carbon resources as vacuum residual oil and oil sand. Using catalysts obtained by loading activated chars made from brown coal into metals, decomposing reactions were performed varying coal types, reaction conditions, and heavy oil types. The hydrogen transfer pyrolytic process uses as its basic reaction transfer of hydrogen from coke precursors to light gravity components as a result of pyrolysis and effects of catalysts. As a result of the experiment, it was made clear that heavy oil decomposing reactions result in large differences because of types of carbon species used as a carrier. HP-C, which has high hydrogenation capability and extremely low coke yield, may be used as a carrier for a desulfurizing catalyst. On the other hand, a carrier made from Yallourn coal through activation treatment achieved extremely high catalytic activity. Thus, light gravity fraction can be obtained from vacuum residual oil at a high yield with an inexpensive catalyst, that is, the combination of brown coal, an abundant resource, with a small amount of iron. 3 figs., 2 tabs.

22669 (CONF-9207203–, pp. 123-126) **Fe(CO)5/sulfur-catalyzed coal liquefaction using steam or alcohol as hydrogen source.** Watanabe, Y. (Kyoto University, Kyoto (Japan). Faculty of Engineering); Yamada, H.; Kawasaki, N.; Wada, K.; Mitsudo, T. 22 Jul 1992. 320p. (In Japanese). From 1. meeting of The Japan Institute of Energy and the 70th Foundation anniversary meeting; Tokyo (Japan); 22-24 Jul 1992. In *Proceedings of the 1st Meeting of the Japan Institute of Energy and the 70th Foundation Anniversary Meeting.* Order Number DE93793523. Source: OSTI; NTIS (US Sales Only).

The paper studies coal liquefaction using steam or alcohol as hydrogen source under pressurization of carbon monoxide and finds that when Fe(CO)5/S system is used as catalyst precursor, liquefied product is obtained at an extremely high yield. Coal liquefaction under carbon monoxide in the autoclave is conducted with Yallourn and Wandoan coals added with a certain amount of steam or alcohol, and a catalyst precursor. The Fe(CO)5/S catalyst system indicates high activity in coal liquefaction using water/carbon monoxide as hydrogen source, and it is clarified that control of the amount of water and reaction temperature enables attainment of high liquefaction yields and oil yields at the same time. On the other hand, Fe(CO)5/S catalyst is found to be effective also in coal liquefaction using alcohol/carbon monoxide as hydrogen source.

Since liquefaction yields are expected to improve by addition of alcohols to coal, a process using mixed alcohols easily obtained from synthesis gas may be possible. 7 refs., 6 figs.

22670 (CONF-9207203–, pp. 127-130) **Structure and reactivity of Wandoan coal liquid residue and design of complete conversion of Wandoan coal.** Sakanishi, K. (Kyushu University, Fukuoka (Japan). Institute of Advanced Material Study); Honda, K.; Kishino, M.; Mochida, I. 22 Jul 1992. 320p. (In Japanese). From 1. meeting of The Japan Institute of Energy and the 70th Foundation anniversary meeting; Tokyo (Japan); 22-24 Jul 1992. In *Proceedings of the 1st Meeting of the Japan Institute of Energy and the 70th Foundation Anniversary Meeting.* Order Number DE93793523. Source: OSTI; NTIS (US Sales Only).

The paper examines reactivity in hydrogenation treatment of coal liquefaction residue and makes analyses of structures of asphaltene in the liquefaction residue and asphaltene in products by hydrogenation treatment. Moreover, direct liquefaction of Wandoan coal by solvent hydrogen transfer/catalytic hydrogenation is carried out for complete conversion. The liquefaction residue and coal are made dry. Coal is deashed in 1 normal hydrochloric acid by reflux treatment. By non-catalyst/solvent hydrogen transfer solubilization, asphaltene decreases to 22 wt% and oil increases to 51 wt%. Accordingly, oil increases also by reaction with hydrogen transfer in liquefaction system as main reaction. In the second stage liquefaction of catalyst hydrogenation after this, HS and HI-BS increase to 71% and 24%, respectively, and BI-THF and THFI components decrease to 2% and 3%, respectively. This indicates that most of W-CLR is converted to oil and asphaltene, and a considerable amount of organic matters in IHFI component can be soluble. 6 refs., 3 figs., 2 tabs.

22671 (CONF-9207203–, pp. 131-134) **Fluidity of coal liquefaction residue.** Nakagawa, T. (Nippon Steel Corporation, Tokyo (Japan)); Sakawa, M. 22 Jul 1992. 320p. (In Japanese). From 1. meeting of The Japan Institute of Energy and the 70th Foundation anniversary meeting; Tokyo (Japan); 22-24 Jul 1992. In *Proceedings of the 1st Meeting of the Japan Institute of Energy and the 70th Foundation Anniversary Meeting.* Order Number DE93793523. Source: OSTI; NTIS (US Sales Only).

Fluidity of the liquefaction residue is studied to secure stabilized operation of a vacuum distillation tower in the coal liquefaction plant. Viscosity measurements are made on liquefaction residues of Wyoming, Wandoan and Illinois No.6 coals. Viscosity is measured as apparent viscosity using an E-type rotational viscometer. Temperature dependence is noticed in activation energy obtained form Arrhenius plots for viscosity values. Both softening temperature and folded point temperature are determined by the structure of residue. It is judged that the residue of Wyoming coal is a pseudoplastic fluid, and the residues of Wandoan coal and Illinois No.6 coal are a non-Bingham fluid with yield values. The higher the temperature is, the smaller the non-Newtonian index is and the lower the coagulation of residue is. Estimated viscosity of the carbonaceous material becomes higher as the degree of coalification of material coals increases. It is presumed that this relates to elongation of the chain length of the side chain which is a unit structure. 4 refs., 4 figs., 3 tabs.

22672 (CONF-9207203–, pp. 135-138) **Product properties in coal flash pyrolysis.** Sasaki, M. (Nippon Steel Corporation, Tokyo (Japan)); Sakawa, M. 22 Jul 1992. 320p. (In Japanese). From 1. meeting of The Japan Institute of Energy and the 70th Foundation anniversary meeting; Tokyo (Japan); 22-24 Jul 1992. In *Proceedings of the 1st Meeting of the Japan Institute of Energy and the 70th Foundation Anniversary Meeting.* Order Number DE93793523. Source: OSTI; NTIS (US Sales Only).

A study is made on effects of thermal decomposition conditions of the coal flash pyrolysis and solvent swelling treatment of coal on properties of tar as a product. Coal pulverized below 200 meshes is sent to the reactor previously set at a predetermined temperature and thermally decomposed in an instant. When reaction temperature is low, it is considered that bridge structures linking unit structures of the coal which is relatively small in binding energy are cut and side chains such as methyl group are not cut. Therefore, tar containing side chains can be obtained. When reaction temperature is high, it is considered that bridges and side chains are cut, and since radical concentration of pyrolytic fragments increases, re-binding between pyrolytic fragments is promoted in parallel with stabilization by hydrogen radicals supplied from outside, and relatively high polymer tar is produced. It is found that stabilization of pyrolytic fragments by hydrogen radicals is promoted by flash pyrolysis of coal pretreated in tetralin at 700°C and in 2-second residence time under the hydrogen atmosphere, and the tar obtained is lightened. 1 ref., 6 figs., 1 tab.

22673 (CONF-9207203–, pp. 139-142) **Catalytic hydrocracking reaction of nascent coal volatile matter under high pressure in a two-stage reactor.** Yamashita, H. (Tohoku University, Sendai (Japan). Institute for Chemical Reaction Science); Chareonpanichi, M.; Takeda, T.; Tomita, A. 22 Jul 1992. 320p. (In Japanese). From 1. meeting of The Japan Institute of Energy and the 70th Foundation anniversary meeting; Tokyo (Japan); 22-24 Jul 1992. In *Proceedings of the 1st Meeting of the Japan Institute of Energy and the 70th Foundation Anniversary Meeting.* Order Number DE93793523. Source: OSTI; NTIS (US Sales Only).

This paper studies possibility of controlling distribution of final pyrolysis product by varying atmospheric gas pressure, catalyst, kind of coal, and first- and second-order reaction temperatures in two-stage reaction of the coal flash heating pyrolysis. Five kinds of coal are used, and Co/Mo and Ni/Mo which are pulverized and presulfurized are used as catalyst. The two-stage reactor is used under pressurization by hydrogen or helium. In the first stage, coal is thermally decomposed, heating it up to 400-600°C at a heating velocity of 10°C/s and retaining it for two minutes. The produced primary volatile matter is immediately led to the catalyst bed in the second stage set at 400-700°C and directly reformed. It is found that a substantial increase in yield of useful liquid content is possible by conducting the two-stage reaction using catalyst under hydrogen pressurization. Coal with high H/C values, sulfurized Mo system catalyst and high hydrogen pressure show high effectiveness for increasing BTX yields. Optimized combination of coal pyrolysis in the first stage and secondary reaction in the second stage is important for increasing yields of the useful content. 3 refs., 1 fig., 3 tabs.

22674 (CONF-9207203–, pp. 143-148) **New technology development for realization of the coal gasification combined cycle power generation system.** Hirato, M. (Research Institute of Energy, Tokyo (Japan)). 22 Jul 1992. 320p. (In Japanese). From 1. meeting of The Japan Institute of Energy and the 70th Foundation anniversary meeting; Tokyo (Japan); 22-24 Jul 1992. In *Proceedings of the 1st Meeting of the Japan Institute of Energy and the 70th Foundation Anniversary Meeting.* Order Number DE93793523. Source: OSTI; NTIS (US Sales Only).

The paper proposes that as a noble use of fossil fuels, the use of coal for power generation is most suitable. The coal gasification combined cycle power generation system has been taken notice of in which the coal gasified is supplied to the gas turbine and the exhaust gas generates steam which is sent to the steam turbine. On the assumption that an inlet temperature of the gas turbine is 1300°C, thermal efficiency is 2-4% higher than that of the pulverized coal-fired power generation. Coal gasification by partial oxidation instantly reaches an equilibrium state because of high temperature, and the gas is theoretically composed of two components of CO and H2. In the entrained bed gasifier, optimal gasification temperature is 1250-1300°C at 30 atm. However, since the gasifier is actually operated at a high temperature of 1500°C or more to fuse ash of the coal, it is necessary to lower the melting point of ash by addition of limestone. The possibility of using limestone-added slag as cement is fairly high. CO2 unit requirement and energy conversion efficiency from coal are superior to those in coal boilers and fluidized bed boilers. 10 figs., 2 tabs.

22675 (CONF-9207203–, pp. 155-158) **Development of a new coal hydrogenation process by Osaka Gas and British Gas.** Kobayashi, K. (Osaka Gas Co. Ltd., Osaka (Japan)). 22 Jul 1992. 320p. (In Japanese). From 1. meeting of The Japan Institute of Energy and the 70th Foundation anniversary meeting; Tokyo (Japan); 22-24 Jul 1992. In *Proceedings of the 1st Meeting of the Japan Institute of Energy and the 70th Foundation Anniversary Meeting.* Order Number DE93793523. Source: OSTI; NTIS (US Sales Only).

This paper reports results of the development of coal hydrogasification process having been promoted jointly by Osaka Gas and British Gas. This is a process in which coal is reacted with hydrogen under the controlled atmosphere of high temperature/pressure utilizing the flash hydropyrolysis to directly obtain methane, BTX, etc. The reactor only conducts preheating of hydrogen necessary for heat balance as an adiabatic reactor by circulating gas inside it, and can keep exothermic reaction of coal and hydrogen. Performance of the new reactor is demonstrated in a 5 ton/day PDU constructed. The PDU can make runs for at most 200kg/h of coal feed, 670Nm^3/h of hydrogen feed, 62 bar of pressure and 1000°C of highest temperature. Coals used are British and American bituminous coals, Australian brown coal, and Taiheiyo coal. Continuous operation for 231 hours is achieved with no troubles such as plugging of the reactor or carbon precipitation. Important engineering information such as continued coal supply and cooling continued taking-out of char is obtained. 1 ref., 4 figs., 2 tabs.

22676 (CONF-9207203–, pp. 159-162) **Effect of melting ash on reactivity of coal char gasification at high temperature.** Lin, S. (Tokyo University of Agriculture and Technology, Tokyo (Japan). Faculty of Engineering); Ninomiya, Y.; Shu, Z.; Hirato, M.; Horio, M. 22 Jul 1992. 320p. (In Japanese). From 1. meeting of The Japan Institute of Energy and the 70th Foundation anniversary meeting; Tokyo (Japan); 22-24 Jul 1992. In *Proceedings of the 1st Meeting of the Japan Institute of Energy and the 70th Foundation Anniversary Meeting.* Order Number DE93793523. Source: OSTI; NTIS (US Sales Only).

The paper studies effects of ash melting states on reactivity and reaction of high temperature gasification from the point of reaction velocity at each gasification conversion ratio when gasifying 4 kinds of coal in a temperature range from 900 to 1500°C. Since, when calculating activation energy from Arrhenius plots of reaction velocity at the conversion ratio of 10%, it is 121 - 230 kJ/mol, reaction is presumed to have advanced in chemical reaction rate controlling. In each kind of coal, reaction velocity in the latter part of the reaction decreases as compared with that in the first part of the reaction, and the temperature where a multiple of the reaction velocity becomes highest exists, which characterizes high temperature gasification (characteristic temperature). The reaction is in chemical reaction controlling around the characteristic temperature, and seems to be in mass transfer rate controlling gradually as the reaction advances. There is a process of ash melting in which ash does not adhere to char → does adhere → does not adhere, with increasing temperature. The ash seems to stick most easily to char around the characteristic temperature. It is considered that char is shut out from reaction gas by the ash which sticked, and reaction activity is losed on the surface of some char. 2 refs., 6 figs., 2 tabs.

22677 (CONF-9207203–, pp. 163-166) **Pore structure of char derived from coal gasification at high temperature.** Zhu, Z. (Tokyo University of Agriculture and Technology, Tokyo (Japan). Faculty of Engineering); Lin, S.; Ninomiya, Y.; Hirato, M.; Horio, M. 22 Jul 1992. 320p. (In Japanese). From 1. meeting of The Japan Institute of Energy and the 70th Foundation anniversary meeting; Tokyo (Japan); 22-24 Jul 1992. In *Proceedings of the 1st Meeting of the Japan Institute of Energy and the 70th Foundation Anniversary Meeting.* Order Number DE93793523. Source: OSTI; NTIS (US Sales Only).

In this study, several kinds of coal are CO2 gasified in a temperature range of 1273-1773K, and pore distribution of the char reacting at each conversion ratio is measured. An effect of port structure on high temperature gasification is studied by correlations between pore surface area is and reaction velocity. The micropore surface area is obtained from the CO2 adsorption method, and the macropore surface area is obtained from pore distribution measured by pressurizing up to 100MPa by mercury porosimeter. The micro surface area decreases with increasing reaction temperature and with increasing conversion ratio. The higher the temperature is, the smaller the surface area is, and when the temperature is above 1673K, the surface area shows a gradual decline. When the temperature is much higher, the size of pore clearly enlarges with an increase in conversion ratio. Good dependence of reaction velocity on the micropore surface area is recognized, but that on the macropore surface area is not. The effect of micropores on reaction velocity is important also in high temperature gasification. 2 refs., 10 figs., 1 tab.

22678 (CONF-9207203–, pp. 167-170) **Development of a coal gasifier with circulating solid particles as heat medium.** Hatate, Y. (Kagoshima Univ., Kagoshima (Japan). Faculty of Engineering); Uemura, Y.; Usukubo, M.; Tanaka, S.; Miyauchi, M.; Ijichi, K.; Tanaka, Y. 22 Jul 1992. 320p. (In Japanese). From 1. meeting of The Japan Institute of Energy and the 70th Foundation anniversary meeting; Tokyo (Japan); 22-24 Jul 1992. In *Proceedings of the 1st Meeting of the Japan Institute of Energy and the 70th Foundation Anniversary Meeting.* Order Number DE93793523. Source: OSTI; NTIS (US Sales Only).

As a coal gasifier, contrived is an entrained bed coal gasifier with a draft tube, the reactor of which is divided into three zones up to down. By the use of circulating heat storage particles, the gasifier has a feature that the devolatization/differentiation process and the gasification (hydrogen production) process can be done separately inside the one apparatus and has no defects like lowering of reactivity and popping of unreated char caused by reverse mixture. In this report, as the first stage of the study, the experiment is conducted on a one-division system apparatus using cold models and hot models. The hot model designed from the cold model experimental data is composed of an outer cylinder with a minor diameter of the tower body of 156 mm and a draft tube with a minor diameter of 10.9 mm, and the tower is filled with ceramic particles and supplies coal char from the tower top by supplying air from the tower bottom for circulation. From the analytical result of gas formed in catalytic reaction with steam, it is recognized that hydrogen is selectively generated and this gasifier is effective for hydrogen production process. 5 figs., 2 tabs.

22679 (CONF-9207203–, pp. 171-172) **Gas permeability of coal plastic layer.** Nomura, S. (Nippon Steel Corp., Tokyo (Japan)); Arima, T.; Okuhara, T. 22 Jul 1992. 320p. (In Japanese). From 1. meeting of The Japan Institute of Energy and the 70th Foundation anniversary meeting; Tokyo (Japan); 22-24 Jul 1992. In *Proceedings of the 1st Meeting of the Japan Institute of Energy and the 70th Foundation Anniversary Meeting.* Order Number DE93793523. Source: OSTI; NTIS (US Sales Only).

From the viewpoint of lengthening the life of coke oven, it is important to elucidate the generation mechanism of dilation pressure during the coal carbonization. In the present report, the influence of carbonizing conditions and physical properties of coal was studied on the gas permeability which is one of the important factors for elucidating the above mechanism and was assumptively calculated from the gas pressure distribution in the softening layer. Both the gas pressure and temperature in the coal layer were experimentally measured under both free and constrained dilations of coke by heightening the temperature of powdery coal sample with which a small diameter bottom-closed tube was filled up. As a result, the gas pressure lowered with enlargement in layer height, which showed an existence of gas flow upwards. A formula to give the pressure distribution in the direction of height was derived from both the gas flow and mass balance. Further, a formula to assumptively calculate the permeability was derived from the pressure distribution. Then, it was made clear that the permeability enlarges with lightening in load to the melting layer, enlargement in specific volume, heightening in heating rate, heightening in inactive content of coal composition and heightening in highest fluidity. 2 refs., 4 figs.

22680 (CONF-9207203–, pp. 173-176) **Investigation of coking pressure during carbonization of coke oven.** Hanaoka, K. (Kawasaki Steel Corp., Tokyo (Japan)); Igawa, I. 22 Jul 1992. 320p. (In Japanese). From 1. meeting of The Japan Institute of Energy and the 70th Foundation anniversary meeting; Tokyo (Japan); 22-24 Jul 1992. In *Proceedings of the 1st Meeting of the Japan Institute of Energy and the 70th Foundation Anniversary Meeting.* Order Number DE93793523. Source: OSTI; NTIS (US Sales Only).

The dilation characteristics of coal are important for the strength control of coke during the coal carbonization. The dilation pressure, if exceeding its permissible limit, causes destruction of heating wall, which necessitates the control to be made in an appropriate range. From the viewpoint of stabilizing the operation and lengthening the life of oven body, the present report reported a

preparation of formulation model to assumptively calculate the dilation pressure influential on the oven wall, which preparation was made through a basic experiment on the generation mechanism of dilation pressure. Assuming that the dilation pressure was obtained as a total pressure loss in both the softening/melting layer and coke layer as far as the oven wall, ventilation resistance was measured in each of the layers and change was experimentally obtained in bulk density of powdery coal by the pressurizing force. The dilation pressure which was experimentally obtained with a small 40kg vessel and corrected in frictional force, etc. because of smallness of that used vessel was almost equal to that calculated through the above model, which was therefore proved to be high in accuracy. Further, a compounding guidance for keeping the operation stable was prepared through investigating the influence of both compounding and carbonizing conditions of coal on the dilation pressure with a use of the above model. 4 refs., 12 figs.

22681 (CONF-9207203–, pp. 177-180) **Study of gas flow pattern in commercial coke oven chamber.** Sekine, H. (Nippon Steel Chemical Co. Ltd., Tokyo (Japan)); Maeno, Y.; Edakuni, T.; Aramaki, T. 22 Jul 1992. 320p. (In Japanese). From 1. meeting of The Japan Institute of Energy and the 70th Foundation anniversary meeting; Tokyo (Japan); 22-24 Jul 1992. In *Proceedings of the 1st Meeting of the Japan Institute of Energy and the 70th Foundation Anniversary Meeting.* Order Number DE93793523. Source: OSTI; NTIS (US Sales Only).

According to the result of discussions on gas flow pattern in a commercial coke oven chamber, using a test furnace as reported in the previous reports, it was known that the flows move toward the furnace length direction on the coal layer side, and toward the furnace height direction in the coke layer/furnace wall clearance. This paper reports an investigative experiment to verify the flow pattern in an actual furnace (with a charge capacity of 25 t/d to 27 t/d). First, the steam concentrations were compared between that in the vicinity of the furnace lid on the furnace top space and that at other positions. The steam concentration distribution showed a high concentration in the vicinity of the furnace lid. According to the result of calculating thereof, the internal gas leak factor has reached 90% to 95%, signifying that most part of the steam and gases generated in the coal layer is discharged outside the furnace before it reaches the furnace lid. Also from an experiment with tracers (N2 and Ar) charged into coal layers, it has been made clear that the softening zone is not a full non-permeable layer in the actual furnace, but the gases in the coal layers have a high ratio of being discharged outside directly. 2 refs., 5 figs., 4 tabs.

22682 (CONF-9207203–, pp. 181-185) **On-line supervision system for benzol recovery plant.** Ishiguro, H. (NKK Corp., Tokyo (Japan)); Matsumura, S.; Oshima, Y.; Tahara, T.; Kawashima, A.; Sato, T. 22 Jul 1992. 320p. (In Japanese). From 1. meeting of The Japan Institute of Energy and the 70th Foundation anniversary meeting; Tokyo (Japan); 22-24 Jul 1992. In *Proceedings of the 1st Meeting of the Japan Institute of Energy and the 70th Foundation Anniversary Meeting.* Order Number DE93793523. Source: OSTI; NTIS (US Sales Only).

This paper summarizes a diagnosis and control expert system for a benzol recovery plant operation among other operation aiding systems used at the K Chemical's plant. The equipment recovers benzene, toluene and xylene (BTX) contained in gases generated from a coke furnace, and consists of two systems; a numerical model system to achieve an optimal operating condition and an anomaly diagnostic system used concentratedly on the operating techniques. The anomaly diagnostic system monitors 131 parameters indicating the plant conditions on a real-time basis, detects an anomaly if any occurs, and guides an operator to inferring and correcting causes of the anomaly. While anomalies include those from operation and devices, the system advises inferred causes and restoration measures if, for example, a condition deviates largely from the normal operating condition. The system is edited with 34 items of information on operation anomaly diagnoses and 300 rules. 5 refs., 5 figs., 1 tab.

22683 (CONF-9207203–, pp. 190-192) **Reoperation results of the formed coke pilot plant.** Oshima, H. (Kawasaki Steel Corp., Tokyo (Japan)); Furuta, K.; Nakagawa, Y.; Kakumaru, T.; Komaki, I. 22 Jul 1992. 320p. (In Japanese). From 1. meeting of The Japan Institute of Energy and the 70th Foundation anniversary meeting; Tokyo (Japan); 22-24 Jul 1992. In *Proceedings of the 1st Meeting of the Japan Institute of Energy and the 70th Foundation Anniversary Meeting.* Order Number DE93793523. Source: OSTI; NTIS (US Sales Only).

A formed coke pilot plant has been developed during a period between 1979 and 1986 under a joint research by the Continuously Formed Coke Research and Development Committee in the Steel and Iron Federation of Japan. The plant has been kept dormant for four years to date. This paper reports the pilot plant recently reoperated from a necessity of its testing for a blast furnace use, with regard to the result of its preparation, construction, operation and restopping. To make the plant capable of being used stably for one year as a criterion, the construction included overhauling valves and blowers; replacing parts in electric instrumentation; spray-cleaning joints in the carbonizing furnace; reapplying dome casters on the high-temperature heating furnace; renewing the front of the low-temperature heating furnace; and cleaning other parts. The operation has continued from the first to the third operation phase on a 4-worker × 4-shift basis for 239 days with a total production of 42,835 tons (dry). The coke quality was found as good as DI at 84.6 and CSR at 56.5, which is nearly equivalent to that obtained under the joint research first written. 3 figs., 1 tab.

22684 (CONF-9207203–, pp. 193-196) **Preheating of coal for continuous coke making process.** Nagumo, A. (Seikei Univ., Tokyo (Japan). Faculty of Engineering); Matsukata, M.; Kojima, T. 22 Jul 1992. 320p. (In Japanese). From 1. meeting of The Japan Institute of Energy and the 70th Foundation anniversary meeting; Tokyo (Japan); 22-24 Jul 1992. In *Proceedings of the 1st Meeting of the Japan Institute of Energy and the 70th Foundation Anniversary Meeting.* Order Number DE93793523. Source: OSTI; NTIS (US Sales Only).

With an aim to realize a three-stage coke lump manufacturing process with rapid heating/agglomeration/uniform low-temperature heating up to just before softening and melting of coal, this paper describes a basic study on its first stage. Shortening carbonizing time, expanding selection scope of raw materials, and improving their quality may be expected by rapidly heating coal up to just before its softening point (about 400°C). With an objective to decide the maximum temperature in the rapid heating and identify relations among solidification characteristics and various conditions, experiments were carried out using a fluidized bed (nitrogen flowing) reactor (batch type) with an inner diameter of 40 mm charged with different types of coal. The following results were obtained: the inter-layer temperature under normal fluidization is uniform; on the other hand, a temperature when the temperature distribution changed rapidly was determined as the solidification temperature; and it was found that in a coal type with larger maximum fluidizing degree the heating was faster, and the larger the fluidizing gas flow rate is, the higher the solidification temperature rises thus the maximum heating temperatures were determined by coal type. 4 figs., 2 tabs.

22685 (CONF-9207203–, pp. 197-200) **Operation of the coal moisture control plant at Kashima No.2 coke battery.** Nishiyama, Y. (Sumitomo Metal Industries Ltd., Osaka (Japan)); Yoda, K.; Yoshida, S.; Yagyu, K.; Kodama, T.; Yabuuchi, K. 22 Jul 1992. 320p. (In Japanese). From 1. meeting of The Japan Institute of Energy and the 70th Foundation anniversary meeting; Tokyo (Japan); 22-24 Jul 1992. In *Proceedings of the 1st Meeting of the Japan Institute of Energy and the 70th Foundation Anniversary Meeting.* Order Number DE93793523. Source: OSTI; NTIS (US Sales Only).

This paper reports operation of the coal moisture control plant at Kashima No. 2 coke battery installed with aims to save energy, improve coke productivity and quality, and stabilize the operation, as well as results of comparing it with conventional moisture control methods. The plant is of a steam tube dryer type (with tubes with a diameter of 3.8 m and a length of 25 m) having a capacity to treat wet steam at 330 t/h and capable of reducing moisture from 10.5% to 6.5%. The system is of completely automatic control. The plant has been operated on a continuous basis since February 1992 without a big trouble controlling moisture at an accuracy of ± 0.2%

to the value. The effect of reducing the quantity of heat for carbonization remains at about -50 Mcal/t currently because of low load operation. The plant is operating with somewhat less steam consumption than the design value. Raised bulk densities assure approximately the same coal charging amount as the conventional methods. No noticeable aggravation has been recognized in coke quality. 8 figs., 1 tab.

22686 (CONF-9207203–, pp. 149-154) **Future prospect of coal hydrogasification techniques.** Kaiho, M. (National Institute for Resources and Environment, Tsukuba (Japan)). 22 Jul 1992. 320p. (In Japanese). From 1. meeting of The Japan Institute of Energy and the 70th Foundation anniversary meeting; Tokyo (Japan); 22-24 Jul 1992. In *Proceedings of the 1st Meeting of the Japan Institute of Energy and the 70th Foundation Anniversary Meeting.* Order Number DE93793523. Source: OSTI; NTIS (US Sales Only).

Hydrogasification technology is outlined as a technology to convert coal which is richer in reserve than petroleum or natural gas to SNG (synthesis gas). This is a technology in which coal is reacted on hydrogen above 800-950°C under the controlled atmosphere more than 30 atm to produce gases mostly including methane. Light distillate as by-product is composed mainly of BTX. It has no tar trouble which becomes the problem in the conventional gasification, and is easily usable. The reaction mechanism has not been elucidated in detail. For SNG production, there are a partial oxidation-methane synthesis method and a hydrogasification method. Both are partial oxidation reaction by oxygen. When considering the global warming, carbon conversion ratio $\simeq 1$ is a requisite condition. Therefore, both methods have no ways to increase efficiency but reduction in oxygen ratio. The entrained bed gasifier method using pulverized coal is desirable for a hydrogasifier. The entrained bed gasifier is desirable also for a hydrogen production furnace. It is necessary to optimize material balance and to enhance efficiency at a stage of producing hydrogen. 3 figs., 2 tabs.

22687 (CONF-9207203–, pp. 201-204) **Hot repair technique of oven wall.** Tsugita, Y. (Nippon Steel Corp., Tokyo (Japan)); Kikuchi, A.; Sumita, Y.; Okanishi, K.; Otsuka, J.; Oda, Y.; Kudo, T.; Shigemi, T. 22 Jul 1992. 320p. (In Japanese). From 1. meeting of The Japan Institute of Energy and the 70th Foundation anniversary meeting; Tokyo (Japan); 22-24 Jul 1992. In *Proceedings of the 1st Meeting of the Japan Institute of Energy and the 70th Foundation Anniversary Meeting.* Order Number DE93793523. Source: OSTI; NTIS (US Sales Only).

Subsequent to the existing techniques for hot repair of furnace edges in repairing degraded walls in a coke furnace, a boring process was developed that replaces only the central part with new bricks. The coke furnace subjected to the repair was a Nittetsu composite furnace with 75 chambers, with the central parts in No.67 and No.68 flue arrays warped with swelling of 67 mm at maximum. The repair was decided to be applied to 9 to 22 flues horizontally and 36 to 64 steps vertically. The construction has been carried out from October 20, 1991 through December 3, 1991 with a sequence of reinforcing the insertion vehicle rails → cooling, inserting heat insulating boxes → dismantling bricks, processing → stacking bricks → heating bricks → preparing brick insertion, spraying → initial insertion, and dry sealing. After the temperature was raised, bricks were given an edge preparation and the edges were sprayed to improve airtightness between the new and old bricks. The furnace temperature and furnace expanding behavior were controlled during these processes. The furnace was restored to a normal operation. 5 figs., 2 tabs.

22688 (CONF-9207203–, pp. 205-208) **Influence of coke oven width on coking time.** Suzuki, N. (NKK Corp., Tokyo (Japan)); Itagaki, S.; Fukada, K. 22 Jul 1992. 320p. (In Japanese). From 1. meeting of The Japan Institute of Energy and the 70th Foundation anniversary meeting; Tokyo (Japan); 22-24 Jul 1992. In *Proceedings of the 1st Meeting of the Japan Institute of Energy and the 70th Foundation Anniversary Meeting.* Order Number DE93793523. Source: OSTI; NTIS (US Sales Only).

There are a large number of reports that in a horizontal chamber type coke furnace the minimum coking time (t) is determined mainly from the furnace width (x_C) , and with $t = kx_C^n$ (k and n are constants), the n ranges from 1.2 to 2. The n closer to 1 reduces a need of increasing the number of furnace gates even if the furnace width is increased, which draws much attention because of the recent trend of increasing furnace sizes. This paper discusses this relationship using calculations with a furnace heat transfer simulation model and a coking test using a small electric oven. The simulation result showed how the n increases when the brick temperature was raised, the furnace width was increased, and the brick thickness was reduced. For example, the n was 1.4 when the temperature was 1200°C, the width was from 400 mm to 600 mm, and the thickness was 100 mm. The facts that the n for the coke furnace is smaller than 2 for flat plate heating and that the value changes depending on conditions were explained from the temperature dependence of the thermal properties. 8 refs., 9 figs.

22689 (CONF-9207203–, pp. 227-230) **Studies on cobalt catalyst for fischer-tropsch synthesis.: Effect of surface acidity and pore structure of SiO2-Al2O3 supports on the composition of their products.** Mori, K. (Kansai University, Osaka (Japan). Faculty of Engineering); Terada, T.; Oda, H.; Yokokawa, C. 22 Jul 1992. 320p. (In Japanese). From 1. meeting of The Japan Institute of Energy and the 70th Foundation anniversary meeting; Tokyo (Japan); 22-24 Jul 1992. In *Proceedings of the 1st Meeting of the Japan Institute of Energy and the 70th Foundation Anniversary Meeting.* Order Number DE93793523. Source: OSTI; NTIS (US Sales Only).

Product distribution in the Fisher-Tropsch synthetic reaction has a Schultz-Flory type carbon distribution, which makes synthesizing certain objects selectively difficult. Discussions have been given recently on catalysts and reactive conditions to attempt controlling this characteristic. This paper discusses effects of surface acidity and pore structure of SiO2, SiO2 -Al2O3 supports on the composition of their products under different conditions. As a result of experiments using a fixed bed flow reactor, the following findings were obtained for example: SiO2 as an F-T synthetic catalyst had higher conversion rate than Al2O3 ; SiO2 and Al2O3 supports having pores from 30Å to 70Å suppressed methanization and accelerated producing hydrocarbon of higher than C11 ; and presence of surface acidic groups in the SiO2-Al2O3 support exhibited effect of producing iso-structures. 4 refs., 1 fig., 3 tabs.

22690 (CONF-9207203–, pp. 237-240) **Hydrodenitrogenation of coal liquids by phenol addition.** Mashimo, K. (Nihon University, Tokyo (Japan). College of Science and Technology); Sugano, M.; Fujimoto, Y.; Wainai, T. 22 Jul 1992. 320p. (In Japanese). From 1. meeting of The Japan Institute of Energy and the 70th Foundation anniversary meeting; Tokyo (Japan); 22-24 Jul 1992. In *Proceedings of the 1st Meeting of the Japan Institute of Energy and the 70th Foundation Anniversary Meeting.* Order Number DE93793523. Source: OSTI; NTIS (US Sales Only).

It is expected that denitrogenation effect will be elevated in hydrodenitrogenation process of coal liquids by means of adding phenol, which is difficult to get decomposed in acidic compounds, to raise acidity of catalysts. Accordingly, a secondary hydrogenation reaction was carried out on acidic, neutral, and basic fractions in primary coal liquids to investigate phenol addition effect. Test samples are the separated fractions of acidic oil and basic oil separated from Akabira primary coal liquid or Miike primary coal liquid using solvents or ion exchange resins. The secondary hydrogenation reaction was performed in an autoclave under an Mo-based catalyst added with 0% to 10% phenol. Addition of phenol accelerated denitrogenation of oil and asphaltene components, which was found attributable to denitrogenation of the contained acidic oil, and effective especially for denitrogenating strong acidic oil containing less hydroxyl groups. No addition effect was discovered in basic oil containing preasphaltene at 53%. 2 refs., 3 figs., 1 tab.

22691 (CONF-9207203–, pp. 265-268) **Conversion of aqueous ethanol to olly products and combustion of coke produced, on Pt-TiO2/SiO2.** Nakano, K. (Fukuoka Univ., Fukuoka (Japan)); Shiraishi, Y.; Yamaguchi, T. 22 Jul 1992. 320p. (In Japanese). From 1. meeting of The Japan Institute of Energy and the 70th Foundation anniversary meeting; Tokyo (Japan); 22-24 Jul 1992. In *Proceedings of the 1st Meeting of the Japan Institute of Energy and the 70th Foundation Anniversary Meeting.* Order Number DE93793523. Source: OSTI; NTIS (US Sales Only).

A Pt-TiO2/SiO2 catalyst was prepared and studied for the purpose of realizing a catalyst which allows ethanol manufactured biotechnologically as a new energy source to be fired completely as fuel in the form of aqueous solution without producing aldehyde etc. It consists of alumina or silica carrier coated with a thin titania layer on which a trace amount of platinum is sustained. An ethanol aq. solution of 0.5 mole fraction was fed through a carburettor at 1.03/h WHSV into a reactor packed with 20g of this catalyst and fired at the reaction temperature of 300°C to obtain highly efficient combustion compared with Pt-SiO2, or Pt-Al2O3. In this case, oily material such as heptene was separated in addition to methane, hydrogen and oxygen. It is a substance peculiar to titania and considered to be produced successively through disintegrated products of alcohol and water and in competetion with coke. 4 figs.

22692 (CONF-930802–1) **Mechanism of HDS/HDN reactions.** Mullins, D.R.; Lyman, P.F. Oak Ridge National Lab., TN (United States). [1993]. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 206. American Chemical Society national meeting; Chicago, IL (United States); 22-27 Aug 1993. Order Number DE93011858. Source: OSTI; NTIS; GPO Dep.

One method for exploring the mechanisms involved in HDS/HDN reactions is to study the elementary reaction steps that occur for model systems using UHV surface science techniques. Our approach has been to examine reactions involving a prototypical organosulfur molecule, methanethiol, adsorbed on different clean and modified metal surfaces. In general, as the surface is heated, this molecule follows two principle reaction pathways on most transition metal surfaces. At low coverages, the molecule undergoes total decomposition producing adsorbed atomic sulfur and carbon and gaseous H_2. At higher coverages a competing pathway results in adsorbed sulfur and gaseous methane. In order to understand these reactions, the different chemical intermediates are identified, and the differences in reactivity for these intermediates are studied as a function of adsorbate coverage, surface composition and sample temperature. Several analytical techniques are employed in these experiments. Temperature programmed desorption, TPD, is used to identify the desorbed reaction products, their desorption temperature and the branching ratio as the system is modified. Auger electron spectroscopy, AES, is used to determine the amount of adsorbed atomic species that result from the reaction. The reaction intermediates are studied by high resolution soft x-ray photoelectron spectroscopy.

22693 (DOE/FTR–93012115) **Travel to Alberta, Canada to discuss the research on Advanced direct coal liquefaction concepts: Foreign trip report, October 18–21, 1992.** Kornfeld, S.C. USDOE Pittsburgh Energy Technology Center, PA (United States). 24 Nov 1992. 6p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93012115. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The purpose of the trip was to discuss the contract titled "Advanced Direct Coal Liquefaction Concepts" and to tour the Alberta Research Council's Devon and Nisku facilities, which are both located near Edmonton. The contract, DE-AC22-92PC91050, was awarded on July 30, 1992 jointly to the Canadian Energy Development, Inc., and the Alberta Research Council (CED/ARC). This new 24 month contract, with a total cost of $1,686,762, is 30 percent cost shared by CED/ARC. The objective of this research is to develop a new approach to liquefaction that generates an all distillate product slate at reduced cost. Highlights are: (1) Autoclave tests are investigating the stability of the coal derived solvent, which will be used in the direct liquefaction program. (2) A laboratory scale demonstration of agglomeration was performed during the tour at Devon. The test showed that loose agglomerates were easily produced from the Wyoming Black Thunder coal, using the coal derived solvent obtained from Wilsonville operations. (3) Visited the five ton/day coal agglomeration facility at Devon. It was used for development of ARC's patented AGLOFLOAT technology. ARC participated in the design of the agglomeration facility at Wilsonville, Alabama, which PETC supported to demonstrate related technology.

22694 (DOE/MC/24116–3363) **Development of an advanced, continuous mild gasification process for the production of co-products: Quarterly report, October 1, 1992–December 31, 1992.** O'Neal, G.W. Coal Technology Corp., Bristol, VA (United States). 1992. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC21-87MC24116. Order Number DE93013989. Source: OSTI; NTIS; GPO Dep.

A 70-pound continuous coke sample was prepared for testing by a major conventional coke producer. Test results were encouraging, but a suggestion was made to produce larger briquettes. Work is underway to produce 6in. x 5in. x 3.75in. briquettes with plans to crush these briquettes to plus 2-inch x minus 3-inch irregular shaped coke. Work continued to provide a coke reactivity test instrument at CTC. A new vessel was fabricated of Haynes HR-160 which will withstand temperatures up to 2300°F. A total of 11 CMGU test runs were completed. Coal feed rates of over 1000 pounds per hour for short periods were obtained. Average feed rates of over 800 pounds per hour were reached for two test runs. The jet burners heating the insides of the screws' shafts made these higher rates possible. Three test runs were made using 28 x 100 mesh Penelec filter cake with the objective of upgrading this coal processing byproduct to coke. Improvements to the PDU continued with two condensers' modifications and improved packing gland seals.

22695 (DOE/MC/24267–3327) **Addendum to industrial market assessment of the products of mild gasification.** North Dakota Univ., Grand Forks, ND (United States). Energy and Environmental Research Center; Sinor (J.E.) Consultants, Inc., Niwot, CO (United States). May 1992. 82p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC21-87MC24267. Order Number DE93000264. Source: OSTI; NTIS; GPO Dep.

The objective of this report is to review and update the 1988 report by J. E. Sinor Consultants Inc., "Industrial Market Assessment of the Products of Mild Gasification, and to more fully present market opportunities for two char-based products from the mild gasification process (MGP): Formcoke for the iron and steel industry, and activated carbon for wastewater cleanup and flue gas scrubbing. Please refer to the original report for additional details. In the past, coal conversion projects have and liquids produced, and the value of the residual char was limited to its fuel value. Some projects had limited success until gas and oil competition overwhelmed them. The strategy adopted for this assessment is to seek first a premium value for the char in a market that has advantages over gas and oil, and then to find the highest values possible for gases, liquids, and tars, either on-site or sold into existing markets. During the intervening years since the 1988 report, there have been many changes in the national economy, industrial production, international competition, and environmental regulations. The Clean Air Act Amendments of 1990 (CAAA) will have a large impact on industry. There is considerable uncertainty about how the Act will be implemented, but it specifically addresses coke-oven batteries. This may encourage industry to consider formcoke produced via mild gasification as a low-pollution substitute for conventional coke. The chemistry and technology of coke making steel were reviewed in the 1988 market assessment and will not be repeated here. The CAAA require additional pollution control measures for most industrial facilities, but this creates new opportunities for the mild gasification process.

22696 (DOE/MC/24267–3329) **Development of an advanced, continuous mild gasification process for the production of co-products: Task 4.6, Economic evaluation.** Cohen, L.R. (Xytel-Bechtel, Inc. (United States)); Hogsett, R.F.; Sinor, J.E.; Ness, R.O. Jr.; Runge, B.D. North Dakota Univ., Grand Forks, ND (United States). Energy and Environmental Research Center. Oct 1992. 187p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC21-87MC24267. Order Number DE93000266. Source: OSTI; NTIS; GPO Dep.

The principal finding of this study was the high capital cost and poor financial performance predicted for the size and configuration of the plant design presented. The XBi financial assessment gave a disappointingly low base-case discounted cash flow rate of return (DCFRR) of only 8.1% based on a unit capital cost of $900 per ton year (tpy) for their 129,000 tpy design. This plant cost is in reasonable agreement with the preliminary estimates developed by J.E.

Sinor Associates for a 117,000 tpy plant based on the FMC process with similar auxiliaries (Sinor, 1989), for which a unit capital costs of $938 tpy was predicted for a design that included char beneficiation and coal liquids upgrading–or about $779 tpy without the liquid upgrading facilities. The XBi assessment points out that a unit plant cost of $900 tpy is about three times the cost for a conventional coke oven, and therefore, outside the competitive range for commercialization. Modifications to improve process economics could involve increasing plant size, expanding the product slate that XBi has restricted to form coke and electricity, and simplifying the plant flow sheet by eliminating marginally effective cleaning steps and changing other key design parameters. Improving the financial performance of the proposed formed coke design to the level of a 20% DCFRR based on increased plant size alone would require a twenty-fold increase to a coal input of 20,000 tpd and a coke production of about 2.6 minion tpy–a scaling exponent of 0.70 to correct plant cost in relation to plant size.

22697 (DOE/MC/25141–3339) **High-pressure coal fuel processor development: Task 1, Proof of principle testing.** Greenhalgh, M.L. Caterpillar, Inc., Peoria, IL (United States). Nov 1992. 33p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC21-88MC25141. Order Number DE93000276. Source: OSTI; NTIS; GPO Dep.

The objective of Subtask 1.1 Engine Feasibility was to conduct research needed to establish the technical feasibility of ignition and stable combustion of directly injected, 3,000 psi, low-Btu gas with glow plug ignition assist at diesel engine compression ratios. This objective was accomplished by designing, fabricating, testing and analyzing the combustion performance of synthesized low-Btu coal gas in a single-cylinder test engine combustion rig located at the Caterpillar Technical Center engine lab in Mossville, Illinois. The objective of Subtask 1.2 Fuel Processor Feasibility was to conduct research needed to establish the technical feasibility of air-blown, fixed-bed, high-pressure coal fuel processing at up to 3,000 psi operating pressure, incorporating in-bed sulfur and particulate capture. This objective was accomplished by designing, fabricating, testing and analyzing the performance of bench-scale processors located at Coal Technology Corporation (subcontractor) facilities in Bristol, Virginia. These two subtasks were carried out at widely separated locations and will be discussed in separate sections of this report. They were, however, independent in that the composition of the synthetic coal gas used to fuel the combustion rig was adjusted to reflect the range of exit gas compositions being produced on the fuel processor rig. Two major conclusions resulted from this task. First, direct injected, ignition assisted Diesel cycle engine combustion systems can be suitably modified to efficiently utilize these low-Btu gas fuels. Second, high pressure gasification of selected run-of-the-mine coals in batch-loaded fuel processors is feasible. These two findings, taken together, significantly reduce the perceived technical risks associated with the further development of the proposed coal gas fueled Diesel cycle power plant concept.

22698 (DOE/MC/25141–3340) **High-pressure coal fuel processor development: Final report.** Greenhalgh, M.L. (Caterpillar, Inc., Peoria, IL (United States)). USDOE Morgantown Energy Technology Center, WV (United States); Caterpillar, Inc., Peoria, IL (United States). Dec 1992. 30p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC21-88MC25141. Order Number DE93000277. Source: OSTI; NTIS; GPO Dep.

Caterpillar shares DOE/METC interest in demonstrating the technology required to displace petroleum-based engine fuels with various forms of low cost coal. Current DOE/METC programs on mild gasification and coal-water-slurries are addressing two approaches to this end. Engine and fuel processor system concept studies by Caterpillar have identified a third, potentially promising, option. This option includes high-pressure fuel processing of run-of-the-mine coal and direct injection of the resulting low-Btu gas stream into an ignition assisted, high compression ratio diesel engine. The compactness and predicted efficiency of the system make it suitable for application to line-haul railroad locomotives. Two overall conclusions resulted from Task 1. First direct injected, ignition assisted Diesel cycle engine combustion systems can be suitably modified to efficiently utilize low-Btu gas fuels. Second, high pressure gasification of selected run-of-the-mine coals in batch-loaded fuel processors is feasible. These two findings, taken together, significantly reduce the perceived technical risk associated with the further development of the proposed coal gas fueled Diesel cycle power plant concept. The significant conclusions from Task 2 were: An engine concept, derived from a Caterpillar 3600 series engine, and a fuel processor concept, based on scaling up a removable-canister configuration from the test rig, appear feasible; and although the results of this concept study are encouraging, further, full-scale component research and development are required before attempting a full-scale integrated system demonstration effort.

22699 (DOE/PC/88940–T14) **Fundamental studies in production of C_2-C_4 hydrocarbons from coal: Final report, 1 September 1988–31 August 1992.** Wiser, W.H.; Oblad, A.G. Utah Univ., Salt Lake City, UT (United States). Mar 1993. 148p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-88PC88940. Order Number DE93014936. Source: OSTI; NTIS; GPO Dep.

The following conclusions can be drawn from the result obtained in this kinetic study of single stage coal gasification to hydrocarbon (HC) gases high in C_2-C_4 hydrocarbons. It was observed that the direct conversion of coal to HC gases involves two steps. The first step is thermal cleavage of the coal structure to produce liquids with small amounts of gases and coke. The second step is conversion of liquids to gases. Coal to liquids occurs very rapidly and was completed within 10 minutes. Liquids to gases is the rate-determining step of the overall process. The conversion of liquids to gases was observed to follow first order kinetics. The first order kinetics treatment of the data by isothermal approximation gave an apparent activation energy of approximately 23 kcal/mol. The first order kinetics treatment of the data by a more rigorous non-isothermal method gave an activation energy of 26 kcal/mol. The quantity of HC gases produced directly from coal reached a constant value of about l0% of the dmmf coal at a reaction time of 10 miutes. Most of the HC gases were produced from the liquids. The study of model compounds shows that conversion of liquids to HC gases.proceeds through a carbonium ion mechanism, and this accounts for the production of C_2-C_4 gases. Liquid to gases occurs by a catalytic hydrocracking reaction.

22700 (DOE/PC/89781–12) **A novel coal feeder for production of low sulfur fuel: Annual technical progress report, October 1, 1991–October 1, 1992.** Khang, S.J.; Keener, T.C.; Line, L. Cincinnati Univ., OH (United States). Coll. of Engineering. [1992]. 26p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-89PC89781. Order Number DE93014978. Source: OSTI; NTIS; GPO Dep.

The following tasks have been performed (1) Change of the single-ended driving mechanism of the inner screw shaft to a double-ended driving mechanism, (2) Study of the total sulfur balance on the feeder reactor system, (3) Analytical measurements of the organic sulfur contents in the feed coal and the product char, (4) Study of the organic sulfur removal efficiency in the feeder reactor, (5) Designing and setting up a combustor which is physically attached to the feeder system, (6) Study of the combustion characteristics of char and volatiles produced from the pyrolysis process in the feeder system, and (7) Modeling the pyrolysis process in the inner screw tube to estimate the heat transfer coefficient. Some preliminary conclusions have been obtained: (1) Double-ended driving mechanism of the inner screw feeder is useful for a uniform stress on the shaft and to raise the reaction temperature without an additional metal torque on the shaft. (2) The total sulfur balance shows that the sulfur removal efficiency of CaO in this reactor is higher than 90%. (3) The organic sulfur in Ohio #8 coal is 1.72% which amounts to 45.4% of the total sulfur content. (4) A 73.1% of the organic sulfur is removed in the dual-screw feeder reactor at a temperature of 475°C with the residence time of 6 min., (5) The S_2O emission from the combustor stack reduces as the coal feeder temperature rises, corresponding to the level of H S release from the dual-screw feeder. (6) The total heating value of the coal does not significantly decrease during the pyrolysis and desulfurization processes in the coal feeder. The decrease is mainly due to the

loss of sulfur from coal. (7) The heat transfer step is the main resistance to the pyrolysis process in this system. The heat transfer coefficient is estimated to be about 331.7 W/m-K.

22701 (DOE/PC/89781–13) **A novel coal feeder for production of low sulfur fuel: Quarterly technical progress report, October 1, 1992–January 1, 1993.** Khang, S.J.; Keener, T.C.; Lin, L. Cincinnati Univ., OH (United States). Coll. of Engineering. [1993]. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-89PC89781. Order Number DE93014973. Source: OSTI; NTIS; GPO Dep.

A dual-screw feeder was designed and constructed for desulfurization of coal. The feeder consists mainly of two concentric screw tubes, the inner tube acting as a coal pyrolyzer and the outer tube acting as a desulfurizer with hot calcined lime pellets or other renewable sorbent pellets. Two basic processes are involved in the development of this reactor: the mild pyrolysis of coal and the reaction of H_2S with calcium based sorbent. It combines the coal pyrolysis and the sulfur removal processes in one reactor. The objective of this project is to study the feasibility of an advanced concept of desulfurization inthe coal feeder. In this quarter, the following tasks have been performed: (1) Measurement of volatile yield at different temperature by using TGA, (2) Elemental analysis of the char products from the pyrolysisprocess in the screw feeder, and (3) Improvement of the sampling system of the combustor. The following preliminary conclusions have been confirmed: (1) In the pyrolysis process, the volatile yield of Ohio No. 8 coal significantly increases between 300–500°C. (2) As devolatilization yield increases, desulfurization yield also increases. (3) The denitrification of Ohio No. 8 coal in the dual-screw feeder increases as the temperature and/or residence time increases.

22702 (DOE/PC/89788–T12) **Novel process for depolymerization of coal to C_2-C_4 hydrocarbons: Progress report No. 13, September 1, 1992–November 30, 1992.** Wiser, W.H.; Oblad, A.G. Utah Univ., Salt Lake City, UT (United States). Dept. of Fuels Engineering. Dec 1992. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-89PC89788. Order Number DE93014969. Source: OSTI; NTIS; GPO Dep.

Experiments for conversion of coal to light hydrocarbon gases in a single stage have been conducted in a batch reactor. Experiments were performed at five temperatures, ranging from 440 to 500°C. A dual-functional catalyst was used, consisting of sulfided nickel-molybdenum supported on alumina, mixed with silica-alumina cracking catalyst. Representative data from those experiments are presented below. They reveal why it appeared necessary to perform experiments in a two-stage reactor system before an optimum prototype system could be designed. In Figure 1, it is observed that the production of liquids from coal, at all of the temperatures presented, occurs rapidly, reaching maximum values in less than five minutes. By contrast, Figure 2 reveals that production of hydrocarbon (HC) gases proceeds much more slowly, and continues throughout the time period of the experiment (60 minutes). Figure 3, containing data for conversion at 500°C, reveals that the continued production of HC gases is accompanied by a corresponding reduction in liquids, indicating that perhaps most of the HC gases are produced from cracking of the liquids. Figure 4 reveals that, at a temperature of 500°C, most of the HC gases are in fact produced from the liquids.

22703 (DOE/PC/89879–T13) **High temperature ceramic membrane reactors for coal liquid upgrading: Final report, September 21, 1989–November 20, 1992.** Tsotsis, T.T. (University of Southern California, Los Angeles, CA (United States). Dept. of Chemical Engineering); Liu, P.K.T.; Webster, I.A. University of Southern California, Los Angeles, CA (United States). Dept. of Chemical Engineering. 1992. 27p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-89PC89879. Order Number DE93014940. Source: OSTI; NTIS; GPO Dep.

Membrane reactors are today finding extensive applications for gas and vapor phase catalytic reactions (see discussion in the introduction and recent reviews by Armor [92], Hsieh [93] and Tsotsis et al. [941]). There have not been any published reports, however, of their use in high pressure and temperature liquid-phase applications. The idea to apply membrane reactor technology to coal liquid upgrading has resulted from a series of experimental investigations by our group of petroleum and coal asphaltene transport through model membranes. Coal liquids contain polycyclic aromatic compounds, which not only present potential difficulties in upgrading, storage and coprocessing, but are also bioactive. Direct coal liquefaction is perceived today as a two-stage process, which involves a first stage of thermal (or catalytic) dissolution of coal, followed by a second stage, in which the resulting products of the first stage are catalytically upgraded. Even in the presence of hydrogen, the oil products of the second stage are thought to equilibrate with the heavier (asphaltenic and preasphaltenic) components found in the feedstream. The possibility exists for this smaller molecular fraction to recondense with the unreacted heavy components and form even heavier undesirable components like char and coke. One way to diminish these regressive reactions is to selectively remove these smaller molecular weight fractions once they are formed and prior to recondensation. This can, at least in principle, be accomplished through the use of high temperature membrane reactors, using ceramic membranes which are permselective for the desired products of the coal liquid upgrading process. An additional incentive to do so is in order to eliminate the further hydrogenation and hydrocracking of liquid products to undesirable light gases.

22704 (DOE/PC/90044–7) **High octane ethers from synthesis gas-derived alcohols: Quarterly technical progress report, April–June 1992.** Klier, K.; Herman, R.G.; Feeley, O.C.; Johansson, M.A. Lehigh Univ., Bethlehem, PA (United States). Jul 1992. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-90PC90044. Order Number DE93013524. Source: OSTI; NTIS; GPO Dep.

The objective of the proposed research is to synthesize high octane ethers, primarily methyl isobutyl ether (MIBE) and methyl tertiary butyl ether (MTBE), directly from $H_2/CO/CO_2$ coal-derived synthesis gas via alcohol mixtures that are rich in methanol and 2-methyl-l-propanol (isobutanol). The overall scheme involves gasification of coal, purification and shifting of the synthesis gas, higher alcohol synthesis, and direct synthesis of ethers. The last stage of the synthesis involves direct coupling of synthesis gas-derived methanol and isobutanol that has been demonstrated by us to occur over superacid catalysts to yield methyl isobutyl ether (MIBE) at moderate pressures and a mixture of methanol and isobutene at low pressures. MIBE is an isomer of MTBE and a process is proposed whereby MTBE from the two alcohols is maximized and MIBE is minimized. This will be achieved by the proper choice of reaction conditions, i.e. intermediate pressures, and of inorganic acid catalysts that are stable at temperatures higher than 200°C, at which the carbonium ion reaction coupling of the two alcohols to MTBE is more effective than the oxonium ion or ester reaction coupling to MIBE. Both organic and inorganic catalysts will be investigated, and the better catalysts of these classes will be subjected to long term performance studies. The long term performance studies of the combined process will extend to 1000 hr and detailed analytical data for all products will be provided.

22705 (DOE/PC/90537–T2) **Sequential low-temperature depolymerization and liquefaction of US coals: Progress report No. 2, January 1–March 31, 1987.** Shabtai, J.S.; Wiser, W.H. Utah Univ., Salt Lake City, UT (United States). Dept. of Fuels Engineering. Apr 1987. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-86PC90537. Order Number DE93015629. Source: OSTI; NTIS; GPO Dep.

One of the main objectives of this project is to investigate the low temperature ($\leq$ 290°C) depolymerization-liquefaction reactions of representative US coals using a 3-step procedure recently developed in our Laboratory. The procedure involves subjecting the coal first to two consecutive depolymerization steps in which different types of intercluster linkages are subjected to preferential cleavage. The depolymerized products obtained have low molecular weights and consist predominantly of monocluster compounds. In the third step of the procedure these simplified depolymerization products are subjected to hydroprocessing and attendant exhaustive hydrodeoxygenation to yield light liquid hydrocarbon mixtures as main products. It is planned under the research program to adapt and optimize the above indicated procedure for US coals of different rank, and to examine the feasibility of the new processing concept for conversion of these coals into light liquid hydrocarbon fuels. A

second major objective of the research program is to subject the lowtemperature depolymerization products (obtained by the first two consecutive steps) to exhaustive structural analysis for the purpose of deriving average structural models for the coals under investigation. Such models are expected to be useful as fingerprints for identification and differentiation of various representative US coals.

22706 (DOE/PC/90537–T3) **Sequential low-temperature depolymerization and liquefaction of US coals: Progress report No. 3, April 1–June 30, 1987.** Shabtai, J.S.; Wiser, W.H. Utah Univ., Salt Lake City, UT (United States). Dept. of Fuels Engineering. Jul 1987. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-86PC90537. Order Number DE93015628. Source: OSTI; NTIS; GPO Dep.

The Elkhorn (Kentucky) coal sample, referred below as EH(KY) coal, had the following ultimate analysis (MAF basis), in wt %: C, 85–36; H, 5.69; N, 1.75; Cl, 0.18; S, 0.72; 0 (diff) 6.30. H/C atomic ratio - 0.80; ash content (dry basis), 6.60 %. The sample showed a calorific value of 14,324 BTU/ib (dry basis). As indicated by its ultimate analysis and calorific value, the EH(Ky) coal was of somewhat higher rank as compared with the previously studied HVB coal sample from Burning Star (Illinois no. 6). The EH (Ky) coal was subjected to the previously developed stepwise depolyermization-liquefaction procedure summarized in Figure 1 [for details see J. Shabtai, T. Skulthai and I. Saito, Am. Chem. Soc. Div. Fuel Chem. Prepr., 31 (4), 15–23 (1986)]. The procedure consists essentially of the following sequential steps: (1) Intercalation of the coal sample with catalytic amounts (5–20 %) of $FeCl_3$, followed by mild hydrotreatment (HT) of the coal-$FeCl_3$ intercalate; (2) base-catalyzed depolymerization (BCD) of the product from step 1, under super-critical conditions; and (3) hydroprocessing (HPR) of the depolymerized product from the two preceding steps, using a sulfided 6Co8Mo catalyst. A systematic study was carried out with the purpose of determining the optimal range of processign conditions for EH (Ky) coal in each step of the above sequential procedure.

22707 (DOE/PC/90537–T4) **Sequential low-temperature depolymerization and liquefaction of US coals: Progress report No. 4, July 1–September 30, 1987.** Shabtai, J.S.; Wiser, W.H. Utah Univ., Salt Lake City, UT (United States). Dept. of Fuels Engineering. Oct 1987. 24p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-86PC90537. Order Number DE93015627. Source: OSTI; NTIS; GPO Dep.

The application of the method to the oil fraction of a product obtained from BS(IL) coal by sequential HT-BCD (see Progress Report no. (1)) is given in Figure 8 (A and B). The latter summarize the structural parameters derived for the oil fraction of the depolymerized BS(IL) coal product obtained by HT at 290°C followed by BCD at 290°C. The data derived on the basis of the analytical results show an average molecular formula $C_{22.6}H_{29.1}O_{3.0}N_{0.24}$ for this fraction. The total amount of rings is 3.9, out of which 1.9 are aromatic and 2.0 are naphthenic. The degree of polymerization is 2.3, which means that the above rings are part of a bicluster naphthenoaromatic system. The derived average structure contains 3 oxygen atoms per molecule. In actual molecules composing the oil fraction, these oxygen atoms could be in the form of phenolic, carboxylic, and etheric groups, as indicated by the FTIR spectrum. Figures 8A and 8B indicate two alternative average molecular structures derived for the oil fraction. Structure A consists of two clusters linked by means of a direct (Ar)C-C(Ar) bond, whereas structure B consists of two clusters linked by means of a furanic ring. Both types of linkages have been indicated as very resistant to cleavage under the conditions of the HT and BCD steps. These types of linkages, however, are easily cleaved in the final hydroprocessing step (HPR) of the procedure.

22708 (DOE/PC/90537–T5) **Sequential low-temperature depolymerization and liquefaction of US coals: Progress report No. 5, October 1–December 31, 1987.** Shabtai, J.S.; Wiser, W.H. Utah Univ., Salt Lake City, UT (United States). Dept. of Fuels Engineering. Mar 1988. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-86PC90537. Order Number DE93015626. Source: OSTI; NTIS; GPO Dep.

A Beulah-Zap (North Dakota) lignite sample, designated below as BZ(ND) lignite, was obtained from the Argonne National Laboratory premium coal program. This lignite had the following ultimate analysis (MAF basis) in wt.%: C, 71.05; H, 5.58; N, 1.17; S, 1.60; 0 (diff), 20.6. The ash content (dry basis) was 6.0 wt.%. As expected, the BZ(ND) lignite had a considerably higher oxygen content (~20.6%) in comparison with that of previously studied coals (Progress Reports nos. 1–4). The BZ(ND) lignite was subjected to a previously developed stepwise depolymerization-liquefaction procedure [for details and recent applications see J. Shabtai and T. Skulthai, Proc. 1987 Internat. Confer. Coal Science, Elsevier, Amsterdam (J.A. Moulijn, K.A. Nater, and H.A.G. Chermin, Eds.), 1987, pp. 761764; and J. Shabtai, T. Skulthai, and I. Saito, Am. Chem. Soc. Div. Fuel Chem. Prepr., 31 (4), 15–23 (1986)]. The procedure, as summarized in Figure 1, consists essentially of the following sequential steps: (1) intercalation of the coal sample with catalytic amounts (5–20 %) of $FeCl_3$ followed by mild hydrotreatment (HT) of the coal-$FeCl_3$ intercalate; (2) base-catalyzed depolymerization (BCD) of the product from step 1, under super-critical conditions; and (3) hydroprocessing (HPR) of the depolymerized product from the two preceding steps, using a sulfided 6Co8Mo catalyst. The results obtained in processing the BZ(ND) lignite according to the above procedure are described.

22709 (DOE/PC/90537–T6) **Sequential low-temperature depolymerization and liquefaction of US coals: Progress report No. 6, January 1–March 31, 1988.** Shabtai, J.S.; Wiser, W.H. Utah Univ., Salt Lake City, UT (United States). Dept. of Fuels Engineering. Jun 1988. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-86PC90537. Order Number DE93015625. Source: OSTI; NTIS; GPO Dep.

Earlier results on the reactions of a Pittsburgh #8 (PA) coal sample, designated below as PB(PA) coal, were described in Progress Report no. 4. Additional work on this coal was performed during the reporting period, as follows: The study of the effect of $FeCl_3$ catalyst concentration upon the efficiency of the HT depolymerization step was extended. Low $FeCl_3$ concentrations, in particular in the range of 3.0 to 7.5 wt%, were investigated at four different HT temperatures (275, 290, 300, and 310°C). It was found that even at the lowest concentration employed (3.0 wt%) $FeCl_3$ is efficient at 290–310°C in causing extensive depolymerization (viz. cleavage of alkylene, e.g., methylene linkages) in the PB(PA) coal framework, as reflected by partial solubilization in THF (7–11 wt%) and attendant high degree of activation of the coal for the subsequent BCD step. Additional BCD experiments with the mildly hydrotreated PB(PA) coal, i.e. , with the partially depolymerized coal product from the HT step, were also performed. In particular, the effect of increased BCD temperature, above 290°C, upon product composition was determined. It was found (see Figure 1) that increase in BCD temperature from 290° to 310°C results in a slight increase in the overall yield of THF solubles. On the other hand, this temperature increase causes a major decrease in the yield of the desirable cyclohexane-soluble (oil) fraction and a corresponding increase in the yield of asphaltol and asphaltene products. This clearly indicates that BCD temperatures above 290°C cause undesirable changes in the composition of the final depolymerized product from PB(PA) coal.

22710 (DOE/PC/90537–T7) **Sequential low-temperature depolymerization and liquefaction of US coals: Progress report No. 7, April 1–June 30, 1988.** Shabtai, J.S.; Wiser, W.H. Utah Univ., Salt Lake City, UT (United States). Dept. of Fuels Engineering. Nov 1988. 18p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-86PC90537. Order Number DE93015624. Source: OSTI; NTIS; GPO Dep.

Suitable conditions for high-yield conversion of a Pittsburgh #8 (Pennsylvania) coal sample, supplied by the Argonne program and designated below as PB(PA) coal, were previously developed (see Progress Report no. 4, pp. 3–15; and Progress Report no. 6, pp. 3–4). In some recent experiments, the yield of low-boiling hydrocarbon fuel fractions (gasoline, kerosene and gas oil; b.p. up to 325°C) from this coal was further increased to a level of 70–72 wt % (MAF basis). The main emphasis of the research work during the reporting period was on the structural analysis of the depolymerized PB(PA) coal, with the uftimate objective of developing an average molecular structure for the predominant (71.5 – 76.0 wt %) oil fraction (fr. no. 6, Figure 1) as well as for the small asphattene and asphaftol fractions (fr. no. 7 and 8, Figure 1) of this

depolymerized product. The oil and asphaltene fractions of the depolymerized PB(PA) coal (Figure 1, fractions #6 and 7, respectively) were analyzed by gas chromatography/mass spectrometry (GC/MS). Figure 2 shows the reconstructed ion chromatogram for the oil fraction of the depolymerized PB(PA) coal. As seen, the bulk of the compounds present in this fraction elute in the 125–225°C range as an incompletely resolved hump. It is indicated that the oil contains a wide range of compound types.

22711 (DOE/PC/90537–T8) **Sequential low-temperature depolymerization and liquefaction of US coals: Progress report No. 8, July 1–September 30, 1988.** Shabtai, J.S.; Wiser, W.H. Utah Univ., Salt Lake City, UT (United States). Dept. of Fuels Engineering. Mar 1989. 20p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-86PC90537. Order Number DE93015623. Source: OSTI; NTIS; GPO Dep.

The quantitative ^{13}C NMR, PMR, GC/MS, and FTIR data, as well as elemental composition data for the depolymerized products obtained from Beulah Zap and Pittsburgh no. 8 coals, (Progress Reports no. 5 and 7; and present report) were input into a structural analysis computer program, based on a modified Brown-Ladner method, to derive average structural parameters and, thereby, average molecular structures for the above-mentioned depolymerized coal products. The emphasis was on the structural analysis of the predominant, 65–80 wt%, oil fractions (cyclohexane-solubles) of the depolymerized products. Examples of average molecular structures derived for the oil fractions of depolymerized Pittsburgh no. 8 coal and Beulah Zap lignite are given in Figure 9. These monocluster structures indicate some features which are typical for some of the components comprising the above oil fractions. However, based on (a) the molecular weight distribution of the fractions as determined by mass spectral analysis; and (b) FTIR data indicating the type and relative concentration of oxygen-containing functional groups in the fractions, ft is possible to design molecular structures for probable components in the above two oil fractions, including mostly monocluster (mono-, bi-, and tricyclic) compounds, accompanied by small amounts of bicluster components. Some examples of probable components in the oil fractions of depolymerized Pittsburgh no. 8 coal and Beulah Zap lignite are indicated in Figure 10.

22712 (DOE/PC/91041–T6) **Preconversion processing of bituminous coals: New directions to improved direct catalytic coal liquefaction: Quarterly report, January 1, 1993–March 31, 1993.** Viking Systems International, Inc., Pittsburgh, PA (United States). Apr 1993. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-91PC91041. Order Number DE93014515. Source: OSTI; NTIS; GPO Dep.

The near equal conversions were obtained even with high coal/liquid ratio (1/3–1/2) for two-step wise high-temperature soaking and the first stage liquefaction. Expected conversions were not observed when vacuum distillation after soaking was used in stead of cyclohexane extraction. This is presumably due to the difficulty with redispersion of vacuum distillated bottoms in the coal liquid, because a batch wise procedure was taken by using glasswares. It is suggested that the proposed procedure in the previous quarter should be tested by a continuous procedure under enough heating conditions to keep low viscosity of the bottoms.

22713 (DOE/PC/91042–T4) **Effects of low-temperature catalytic pretreatments on coal structure and reactivity in liquefaction: Technical progress report, December 1992–March 1993.** Song, C.; Saini, A.K.; Wenzel, K.; Huang, L.; Hatcher, P.G.; Schobert, H.H. Pennsylvania State Univ., University Park, PA (United States). Dept. of Materials Science and Engineering. Apr 1993. 55p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-91PC91042. Order Number DE93014941. Source: OSTI; NTIS; GPO Dep.

This work is a fundamental study of catalytic pretreatments as a potential preconversion step to low-severity liquefaction. The ultimate goal of this work is to provide the basis for the design of an improved liquefaction process and to facilitate our understanding of those processes that occur when coals are initially dissolved. The main objectives of this project are to study the effects of low-temperature pretreatments on coal structure and their impacts on the subsequent liquefaction. The effects of pretreatment temperatures, catalyst type, coal rank and influence of solvent will be examined. We have made significant progress in the following four aspects during this quarterly period: (1) influence of drying and oxidation of coal on the conversion and product distribution in catalytic liquefaction of Wyodak subbituminous coal using a dispersed catalyst; (2) spectroscopic characterization of dried and oxidized Wyodak coal and the insoluble residues from catalytic and thermal liquefaction; (3) the structural alteration of low-rank coal in low-severity liquefaction with the emphasis on the oxygen-containing functional groups; and (4) effects of solvents and catalyst dispersion methods in temperature-programmed and non-programmed liquefaction of three low-rank coals.

22714 (DOE/PC/91043–T6) **An investigation of the role of water on retrograde/condensation reactions and enhanced liquefaction yields: Quarterly progress report, January 1, 1993–March 31, 1993.** Miknis, F.P. Western Research Inst., Laramie, WY (United States). Apr 1993. 24p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-91PC91043. Order Number DE93014942. Source: OSTI; NTIS; GPO Dep.

Changes in coal structure that may occur during coal drying will be measured in order to determine the effects of coal drying on its reactivity toward liquefaction. Different methods for coal drying will be investigated to determine if drying can be accomplished without destroying coal reactivity toward liquefaction, thereby making coal drying a relatively economical and efficient method for coal pretreatment. Coal drying methods will include conventional thermal drying, microwave drying and chemical drying at low temperature. State-of-the-art solid-state nuclear magnetic resonance (NMR) techniques using combined rotation and multiple pulse spectroscopy (CRAMPS) and cross polarization with magic-angle spinning (CP/MAS) will be employed: (1) to measures changes in coal structure brought about by the different methods of drying and by low temperature oxidation, and (2) to obtain direct measurements of changes in the aromatic hydrogen-to-carbon ratio of the solid/semisolid material formed or remaining during pretreatment and the initial stages of liquefaction. The objectives for this quarter were to begin coal drying experiments using thermal, microwave, and chemical methods, and to begin coal liquefaction experiments on the dried coals. Three additional coal samples have been acquired. These are a Black Thunder Mine coal acquired from Arco Coal Co, and a Texas subC and Illinois No. 6 hvC acquired from the DOE coal sample bank at Penn State. The samples are listed as DECS-1 and DECS-2, respectively in the PSU sample bank. The ultimate and proximate analyses for all the samples are given in Table 1. Work on each of the subtasks is described in separate paragraphs.

22715 (DOE/PC/91050–T1) **Advanced direct coal liquefaction concepts: Quarterly report, October 1, 1992–December 31, 1992.** Berger, D.J. (Canadian Energy Development, Inc., Edmonton, AB (Canada)); Parker, R.J.; Simpson, P.L. Canadian Energy Development, Inc., Edmonton, AB (Canada); Alberta Research Council, Edmonton, AB (Canada). 1992. 43p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-92PC91050. Order Number DE93015054. Source: OSTI; NTIS; GPO Dep.

During the first quarter of FY 1993, the Project proceeded close to the Project Plan. The analysis of the feed material has been completed as far as possible. Some unplanned distillation was needed to correct the boiling range of the Black Thunder solvent used during the autoclave tests. Additional distillation will be required if the same solvent is to be used for the bench unit tests. A decision on this is still outstanding. The solvent to be used with Illinois No. 6 coal has not yet been defined. As a result, the procurement of the feed and the feed analysis is somewhat behind schedule. Agglomeration tests with Black Thunder coal indicates that small agglomerates can be formed. However, the ash removal is quite low (about 10%), which is not surprising in view of the low ash content of the coal. The first series of autoclave tests with Black Thunder coal was completed as planned. Also, additional runs are in progress as repeats of previous runs or at different operating conditions based on the data obtained so far. The results are promising indicating that almost complete solubilization (close to 90%) of Black Thunder coal can be achieved in a CO/H_2O environment at our anticipated process conditions. The design of the

bench unit has been completed. In contrast to the originally planned modifications, the bench unit is now designed based on a computerized control and data acquisition system. All major items of equipment have been received, and prefabrication of assemblies and control panels is proceeding on schedule. Despite a slight delay in the erection of the structural steel, it is anticipated that the bench unit will be operational at the beginning of April 1993.

22716 (DOE/PC/91050–T2) **Advanced direct coal liquefaction concepts: Quarterly report, August 1–September 30, 1992.** Canadian Energy Development, Inc., Edmonton, AB (Canada); Alberta Research Council, Edmonton, AB (Canada). 26 Oct 1992. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-92PC91050. Order Number DE93015064. Source: OSTI; NTIS; GPO Dep.

The Project was started August 1, 1992. During these first two months, the Project Management plan was issued and approved during discussions at the Pittsburgh Energy and Technology Centre. Feed materials for the experimental work (with the exception of the second solvent) have been received. The analytical work up of these feed materials has been completed, and autoclave stability tests with the solvent and solvent fraction have been performed and analyzed. The Project is proceeding on schedule.

22717 (DOE/PC/91054–T5) **Effect of pretreating of host oil on coprocessing: Quarterly progress report, July 1, 1992–September 30, 1992.** Wender, I.; Tierney, J.W. Pittsburgh Univ., PA (United States). Dept. of Chemical and Petroleum Engineering. 25 Jan 1993. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-91PC91054. Order Number DE93014946. Source: OSTI; NTIS; GPO Dep.

The principal objective of this research is to determine the role host petroleum-derived oils (1000°F+), as well as that of catalytically treated host oils, play when used as liquefaction solvents in coprocessing with coal. The host oils will be extensively characterized and then pretreated in a number of ways which involve catalytic reactions such as hydrogenation, hydrocracking, isomerization, and dehydrogenation. The pretreated oils will then be characterized. The effects of the host oil on coprocessing with coal will be compared to those obtained using catalytically modified heavy oils. When appropriate, model compounds will be used to study specific reactions brought about by the pretreatments. Highly dispersed iron catalysts modified by the addition of small amounts of other metals will be used to modify the chemical composition of the host oils. To date, five different pretreatment reactions have been carried out on the Amoco oil. Table 1 list some properties of this oil. Details of the reaction conditions used are given in Table 2. An objective of the pretreatment reactions is to increase hydrogen content without too significant a breakdown (cracking) of the hydrocarbon structures. Severe cracking could produce a light hydrocarbon solvent which may not be suitable for coprocessing because of its low boiling point. Based on the yield of the pentane soluble fraction, Run 5, with the Shell supported catalyst produced the highest yield of oils. Specifically, the oil content of the starting residuum was increased by more than five percentage points. The next step will be to analyze the products of the pretreatment runs to determine their hydrogen content and other chemical characteristics. The characterization tests will indicate whether the pretreatment reactions were successful in increasing the hydrogen content of the starting heavy oil to the desired levels. If necessary, different pretreatment reactions will be conducted.

22718 (DOE/PC/91059–T4) **Biological upgrading of coal liquids: Quarterly report, October–December 31, 1992.** Engineering Resources, Inc., Fayetteville, AR (United States). 1992. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-91PC91059. Order Number DE93014950. Source: OSTI; NTIS; GPO Dep.

Culture screening and performance studies were performed with a variety of cultures in removing nitrogen compounds from coal liquid. Two cultures were shown to be effective in removing 17 and 26 percent of the nitrogen in coal liquid as determined by elemental analysis. Experiments will continue in an effort to find additional cultures and isolates able to degrade nitrogen, as well as oxygen and sulfur as heteroatom compounds, from coal liquids. A biological process for upgrading of coal liquids would offer significant advantages, such as operation at ordinary temperature and pressure with better energy efficiency. Of greater importance is the fact that microorganisms do not require an external supply of hydrogen for heteroatom removal, obtaining required hydrogen from water. Furthermore, the biocatalysts are continuously regenerated by growth on the heteroatom compounds. Ring structures are degraded as the heteroatoms are removed. The heteroatoms are in an inocuous form, such as NH_3, SO_4^{2-} CO_2 and H_2O. Therefore, there is significant potential for the development of an economical biological process for upgrading of coal liquids.

22719 (DOE/PC/91281–T5) **Low severity coal liquefaction promoted by cyclic olefins: Quarterly report, October–December 1992.** Curtis, C.W. Auburn Univ., AL (United States). Dept. of Chemical Engineering. 1992. 31p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-91PC91281. Order Number DE93014948. Source: OSTI; NTIS; GPO Dep.

Low severity coal liquefaction promoted by cyclic olefins offers a means of liquefying coal at low severity conditions. Lower temperature, 350°C, and lower hydrogen pressure, 500 psi, have been used to perform liquefaction reactions. The presence of the cyclic olefin, hexahydroanthracene, made a substantial difference in the conversion of Illinois No. 6 coal at these low severity conditions. The Researchperformed this quarter was a parametric evaluation of the effect of different parameters on the coal conversion and product distribution from coal. The effect of the parameters on product distribution from hexahydroanthracene was also determined. The work planned for next quarter includes combining the most effective parametric conditions for the low severity reactions and determining their effect. The second part ofthe research performed this quarter involved performing Fourier transform infrared (FTIR) spectroscopy using cyclic olefins. The objective of this study was to determine the feasibility of using FTIR and a heated cell to determine the reaction pathway that occurs in the hydrogen donation reactions from cyclic olefins. The progress made to date includes evaluating the FTIR spectra of cyclic olefins and their expected reaction products. This work is included in this progress report.

22720 (DOE/PC/91289–T6) **Characterization of the organic-sulfur-degrading enzymes: [Quarterly] technical report, December 1, 1992–February 28, 1993.** Ho, N.W.Y. Purdue Univ., Lafayette, IN (United States). Lab. of Renewable Resources Engineering. 1993. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-91PC91289. Order Number DE93014944. Source: OSTI; NTIS; GPO Dep.

The objective of this project is to characterize and purify the enzymes involved in degrading organic sulfur in coal from two well characterized organic sulfur degrading strains, IGTS8 and K3B. We believe that characterization and purification of these enzymes may provide valuable information that will lead to developing or isolating better strains for desulfurization of coal. Our recent results imply that the IGTS8 enzymes are firmly attached to the cell wall, most likely that they are covalently bonded to the cell wall. We believe that for coal desulfurization, it is better to have a microorganism that can secrete its desulfurization enzymes into the medium. The enzymes can penetrate into coal hundreds of times better than a bacterial cell. Thus we have changed the priority of this project. We believe that the isolation of a mutant of IGTS8 which can release the desulfurization enzymes into the cultural medium will be able to develop a much improved microbial process for coal desulfurization. Furthermore, the isolation of sucha mutant will be able to shed some light on how the wild type IGTS8 desulfurization enzyme are attached to the cell wall and make the purification of these enzymes much easier to accomplish.

22721 (DOE/PC/92521–T7) **Stabilization of spent sorbents from coal gasification: Technical report, December 1, 1992–February 28, 1993.** Abbasian, J. (Institute of Gas Technology, Chicago, IL (United States)); Hill, A.H.; Wangerow, J.R.; Banerjee, D.D. Illinois Dept. of Energy and Natural Resources, Springfield, IL (United States). 1993. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC22-92PC92521. Order Number DE93013626. Source: OSTI; NTIS; GPO Dep.

The objective of this investigation is to determine the kinetics of reactions involving partially sulfided dolomite and oxygen, which is needed for the design of the reactor system for the stabilization of

sulfide-containing solid wastes from gasification of high sulfur coals. To achieve this objective, samples of partially sulfided dolomite are reacted with oxygen at a variety of operating conditions in a fluidized-bed reactor, where external diffusion limitations are avoided by using small quantities of the sorbent and maintaining a high flow rate of the reactant gas. The reacted sorbents are analyzed to determine the extent of conversion as a function of operating variables including sorbent particle size, reaction temperature and pressure, and oxygen concentration. Samples of the partially sulfided dolomite were reacted with oxygen in the fluidized-bed rector at different operating conditions. The test parameters included the effects of solid residence time, oxygen concentration, and reaction temperature. The reacted solids were analyzed to determine the extent of CaS conversion to $CaSO_4$. The results of the tests conducted so far in the project indicate that the extent of conversion increase with increasing oxygen concentration and the solid residence time. The rate of reaction appears to be very sensitive to the reaction temperature.

22722 (DOE/PC/92521–T13) **NA/CA catalyzation of Illinois coals for gasification: Technical report, December 1, 1992–February 28, 1993.** Jha, M.C. (AMAX Research and Development Center, Golden, CO (United States)); McCormick, R.L.; Banerjee, D.D. Illinois Dept. of Energy and Natural Resources, Springfield, IL (United States). 1993. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC22-92PC92521. Order Number DE93013632. Source: OSTI; NTIS; GPO Dep.

Three of the most pressing technical problems in gasification of Illinois coals are high reaction temperatures, agglomerating tendency of the coals, and sulfur content of the product gas. This program explores the use of gasification catalysts which reduce gasification temperature, agglomeration tendency, and sulfur emissions. The catalysts are sodium/calcium mixtures and are active at loadings less than 1 weight percent, although higher loading may be required. During the second quarter, we have continued work, "Catalyzed Coal Preparation and Characterization." We have also initiated work on, "Bench Scale Gasification Tests." Work included expansion of the test series for wet impregnated IBC-105 coal. It was determined that catalyst addition at pH 4.5 or lower resulted in almost complete elimination of caking tendency as determined by measurement of the free swelling index (FSI). Characterization of this suite of samples by FTIR, CO_2 Chemisorption (to measure catalyst dispersion), and TGA gasification rate was also performed. Results show correlations between impregnation pH and catalyst dispersion (low pH = high dispersion) and between dispersion and reaction rate. FTIR results suggest the formation of highly dispersed catalyst by interaction with the coal hydroxyl groups.

22723 (DOE/PC/92521–T19) **Microbial strain improvement for organosulfur removal from coal: Technical report, December 1, 1992–February 28, 1993.** Kilbane, J.J. II (Institute of Gas Technology, Chicago, IL (United States)); Ho, K. Illinois Dept. of Energy and Natural Resources, Springfield, IL (United States). [1993]. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC22-92PC92521. Order Number DE93013638. Source: OSTI; NTIS; GPO Dep.

IGT has developed a microbial culture of Rhodococcus rhodochrous, designated as IGTS8, that is capable of specifically cleaving carbon-sulfur bonds in a range of organosulfur model compounds and is capable of removing organic sulfur from coal and petroleum without significantly sacrificing the calorific value of the fuel. Although IGTSS possesses the ability to specifically remove organic sulfur from coal, a major research need is to develop strains of microorganisms that possess higher levels of desulfurization activity. During the past quarter, the DNA sequence of the promoter region of the chloramphenicol resistance gene of pRF2 was determined and tentatively localized to a 50 bp region. To further define the important sequences of this promoter mutants were generated that may have altered promoters allowing higher levels of expression of the chloramphenicol resistance gene. The promoter region from twenty such mutants has been subcloned. Additionally, promoter probe vectors were used to isolate small DNA fragments from the chromosome that possess promoters. These studies will lead to the identification and/or the construction of particularly strong Rhodococcus promoters which will subsequently be used to express the desulfurization genes.

22724 (DOE/PC/92521–T30) **Investigation of a sulfur reduction technique for mild gasification char: Technical report, December 1, 1992–February 28, 1993.** Knight, R.A. (Institute of Gas Technology, Chicago, IL (United States)); Banerjee, D. Illinois Dept. of Energy and Natural Resources, Springfield, IL (United States). [1993]. 27p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC22-92PC92521. Order Number DE93013649. Source: OSTI; NTIS; GPO Dep.

The objective of this program is to investigate the desulfurization of mild gasification char using H_2:CH_4 mixtures. Mild gasification of coal produces char, liquids, and gases at 1000°–1500°F (538°-816°C) and near-ambient pressure. Char, comprising 60–70% of the product, can be used to make high-value form coke for steelmaking and foundries. However, a sulfur content below 1 wt% is desirable, and char from high-sulfur Illinois coals must be upgraded to meet this criterion. Illinois No. 6 chars were treated in a 2-inch batch fluidized-bed reactor with H_2:CH_4 blends containing 9–24 vol % CH_4 at 1100°-1600°F (538°-871°C) and 50–200 psig (0.35–1.38 Mpa). The data from these tests show sulfur removal of 6.0–92.5 wt % and carbon losses of 0.0–25.6 wt %, with the desulfurization susceptibility of char related to porosity, density, and crystallite size. The relationships among mild gasification parameters, char properties, and char desulfurization susceptibility are being studied. Acid washing of char to remove Ca and Fe is being explored for its effect on subsequent sulfur removal. Secondary desulfurization of form coke produced from the desulfurized chars is also being studied, and a final recommendation will be made for integration of char desulfurization into the IGT MILDGAS process.

22725 (DOE/PC/92521–T32) **Mild temperature gasification: Partitioning sulfur to gas as H_2S: Technical report, December 1, 1992–February 28, 1993.** Stencel, J.M. (Kentucky Univ., Lexington, KY (United States). Center for Applied Energy Research); Neathery, J.K.; Schaefer, J.L.; Yang, J.; Banerjee, D. Illinois Dept. of Energy and Natural Resources, Springfield, IL (United States). [1993]. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC22-92PC92521. Order Number DE93013652. Source: OSTI; NTIS; GPO Dep.

Bench-scale, mild-temperature fluidized bed gasification (MTFBG) of three high sulfur Illinois basin coals (IBC) mixed with phosphoric acid will be performed to initiate development of an advanced processing technology which partitions coal sulfur to the gas phase as H_2S. The influence of coal type, coal agglomeration, and steam injection on the properties of the solid, condensible and gaseous products produced during MTFBG will be examined. Analytical measurements of the products will be obtained and are designed to provide product quality and quantity. Combustion reactivity testing of the char, and pressurized, hot water extraction of H_3PO_4 from the char, will be performed to provide information for design of a continuous and integrated process for the removal and recovery of coal sulfur. During this quarter, the acquisition and construction of equipment to be used for MTFBG of Illinois coals and hot water, pressurized filtration of chars were completed. IBC 106 was subjected to fluidized bed gasification testing under nitrogen and steam/nitrogen atmospheres. The percentage of total sulfur removed from the parent coal using physical cleaning followed by MTFBG of coal/phosphoric acid mixtures was as high as 94% at a gasification temperature of 500°C.

22726 (DOE/PC/92527–T2) **Hindered diffusion of coal liquids: Quarterly report No. 2, December 18, 1992–March 17, 1993.** Tsotsis, T.T. (University of Southern California, Los Angeles, CA (United States). Dept. of Chemical Engineering); Sahimi, M.; Webster, I.A. University of Southern California, Los Angeles, CA (United States). Dept. of Chemical Engineering; Unocal Corp., Los Angeles, CA (United States). 1993. 26p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-92PC92527. Order Number DE93014966. Source: OSTI; NTIS; GPO Dep.

Throughout the experimental runs we utilize a high pressure, high temperature diffusion cell system. This diffusion system has been tested through the measurement of the diffusivity of a number of model coal liquids. The heart of the experimental system is a high pressure autoclave, which in its interior can accommodate

one or several ceramic membranes. One side of these membranes is exposed to the contents of the autoclave, while the other side, through an independent flow system, is exposed to flowing pure solvent. The pressure in the interior and exterior of the membranes can be independently adjusted and controlled. This is also true with the flow rate of the solvent in the interior of the membrane. The diffusion experiments are initiated by placing the coal liquid solution (model liquids or asphaltenes) in the autoclave space exterior of the membrane, pressurizing the exterior and interior membrane volumes and initiating the flow of the solvent. One has the option of running the experiment in a batch (exterior)-continuous (interior) or batch-batch mode. The option also exists for loading catalyst in the exterior volume either in a pellet or slurry form or using metal impregnated membranes for simultaneously studying transport and reaction. Model membrane preparation and characterization will be carried out both at USC at the UNOCAL Science and Technology Division, of UNOCAL Corporation (USTD). UNOCAL, in addition, will contribute technician and machine time on apparatuses, such as Auger and XPS, preparative GPC, SEC, XRF, SEC/ICP, Low Angle Light Scattering Photometer, Electron Microscope, Atomic Adsorption, Porosimeters and BET. The project is of both experimental and theoretical nature and is divided into a number of tasks, a brief description of which.

22727 (DOE/PC/92531–T1) **Heteronuclear probes of coal structure and reactivity: Quarterly report, October 30, 1992–January 31, 1993.** Iowa State Univ. of Science and Technology, Ames, IA (United States). Iowa State Mining and Mineral Resources Research Inst. [1993]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-92PC92531. Order Number DE93015056. Source: OSTI; NTIS; GPO Dep.

One of the goals of the proposal was to take advantage of the thermodynamically strong P-S bond to remove sulfur from solid coals with organophosphorus compounds. Using commercially available Bu_3P, we were very pleasantly surprised (after a number of runs carried out by Dr. Mohan, see Table 1) to realize how well this worked on an Illinois No. 6 sample in run No. 5. Using the quantitative ^{31}P NMR technique we have very recently developed for phenols in liquid coal materials in collaboration with CONSOL (see proposal), we have determined from integration of the Bu3PS peak in the Bu_3P extract (49 ppM), that of the 5.31% total sulfur present in the coal sample, we were able to extract 4.83% of it into the Bu_3P. This represents removal of 91% of the sulfur. What makes this result particularly exciting is that in separate experiments, Bu_3P is unsuccessful in removing sulfur from thiophene or from FeS. This rather forcefully reminds us once again that chemistry in the coal matrix can be very different from that on model compounds.

22728 (DOE/PC–93007525, pp. 18-25) **Overview of the Pittsburgh Energy Technology Center.** USDOE Pittsburgh Energy Technology Center, PA (United States). 1993. In *PETC Review: Issue 7, Winter 1992–1993.* 52p. Order Number DE93007525. Source: OSTI; NTIS.

In previous issues of the PETC Review, the authors discussed various projects and programs being conducted by and for the Pittsburgh Energy Technology Center (PETC). This issue reviews some of the mechanisms that allow outside sources (e.g., universities, private-sector corporations, individuals) to perform work for the US Department of Energy (DOE) through funding from PETC; PETC's mission and organization; and the procurement mechanisms within DOE, including a summary of key terms and processes involved in the procurement and contract evaluation process.

22729 (PNL-SA–21664) **Results of catalyst testing using iron-based catalysts.** Linehan, J.C.; Darab, J.G.; Matson, D.W. Pacific Northwest Lab., Richland, WA (United States). Mar 1993. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-930304–16: 205. American Chemical Society national meeting, Denver, CO (United States), 28 Mar - 2 apr 1993). Order Number DE93010794. Source: OSTI; NTIS; GPO Dep.

As coal liquefaction catalysts, iron-based products are generally inferior to the more expensive molybdenum, cobalt, or nickel-based materials. However, the lower costs of production and recovery (or in the case of some iron catalysts, non-recovery) give the iron-based materials a potential economic advantage over the more efficient precious and semi-precious metal catalysts for this application. Recent research has shown that a number of different iron-containing materials can be successfully utilized as coal liquefaction catalysts or as catalyst. Pyrrhotite ($Fe_{1-x}S$) or a similar iron-sulfide phase is commonly believed to be the active catalyst in coal liquefaction and model compound pyrolysis reactions, although no specific phase has been yet been isolated as the actual catalyst species. The active iron-containing catalyst is usually generated in situ from an iron-oxide precursor and an elemental sulfur source under reducing conditions in the reactor vessel. Most research has concentrated on the use of common iron-oxide phases such as hematite or goethite (and their derivatives) as the iron-bearing precursor, or on non-specific iron materials produced by the reaction of various iron salts and compounds in the coal or liquefaction reactor. To our knowledge there has been no systematic effort to determine the optimum iron-containing precursor phase for producing active coal liquefaction catalysts, despite the fact that there are over ten iron-(hydroxy)oxide phases which can be easily synthesized in the laboratory. We have undertaken a systematic study to identify the most active iron-oxide catalyst precursor phases, the co-catalysts, and the coal pretreatments which will provide optimum yields in coal liquefaction processes.

22730 (PNL-SA–21665) **Preparation of ultrafine catalyst powders using a flow-through hydrothermal process.** Matson, D.W.; Linehan, J.C.; Darab, J.G. Pacific Northwest Lab., Richland, WA (United States). Mar 1993. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-930304–15: 205. American Chemical Society national meeting, Denver, CO (United States), 28 Mar - 2 apr 1993). Order Number DE93011603. Source: OSTI; NTIS; GPO Dep.

The rapid thermal decomposition of solutes (RTDS) process was used to produce ultrafine iron-bearing oxide and hydroxide powders for use as coal liquefaction catalysts. The RTDS process subjects aqueous solutions containing dissolved metal salts to elevated temperatures and pressures in a flow-through apparatus. Particle formation is initiated during brief exposure of the solution to a heated region, then is quenched by abruptly cooling and depressurizing the suspension. Powders having individual crystallites on the nanometer to tens-of-nanometer size scale are readily produced by the RTDS method. Variations in RTDS processing parameters (e.g., solute concentration, flow rate, processing temperature) affect the crystallinity, morphology, and size of particles produced. Powders generated using the RTDS process were characterized using XRD, EXAFS, electron microscopy, Mossbauer spectroscopy, and BET surface area analysis.

0105 Products and By-Products

Refer also to citation(s) 22682, 22724, 24068

0106 Properties and Composition

Refer also to citation(s) 22665, 22701, 22713, 22716, 22768, 23337, 23339

22731 (CONF-9207203–, pp. 67-70) **Roles of non-covalent interactions in coal structure.** Iino, M. (Tohoku University, Sendai (Japan). Institute for Chemical Reaction Science); Liu, H.; Sanokawa, Y.; Takanohashi, T.; Nakamura, K.; Murata, S.; Nomura, M. 22 Jul 1992. 320p. (In Japanese). From 1. meeting of The Japan Institute of Energy and the 70th Foundation anniversary meeting; Tokyo (Japan); 22-24 Jul 1992. In *Proceedings of the 1st Meeting of the Japan Institute of Energy and the 70th Foundation Anniversary Meeting.* Order Number DE93793523. Source: OSTI; NTIS (US Sales Only).

To elucidate the non-covalent bonding interactions in the coal structure, investigation was made on the solubility of coal by taking several types of electronic donator and acceptor as an additive. Pyridine insoluble (PI) was obtained by extracting extract from Upper Freeport bituminous coal at ordinary temperature with mixed CS2-N-methyl-2-pyrrolidinone (NMP) solvent and reextracting acetone insoluble from the above extract with pyridine. Redissolution

experiment was made by adding the PI fraction and additive to the CS2-NMP. Without additive, the solubility was only 55.1% through association based on the non-covalent bonding interactions in the PI fraction. However, most of the PI fraction was made to dissolve with addition of 7,7,8,8-tetracyanoquinodimethane (TCNQ), tetracyanoethylene (TCNE) and p-phenylenediamine which are electronic donators and acceptors to contribute to the interactions of electric change's moving type. Complex formation was suggested between the PI fraction and TCNE from the UV absorption spectra. Therefore, it is judged that the interactions (association) in the PI fraction itself are attacked and released by the added TCNE, which simultaneously produces a new complex of electric charge's moving type between the PI fraction and TCNE, and then, makes the PI fraction dissolve. 2 refs., 3 figs., 2 tabs.

22732 (CONF-9207203–, pp. 71-74) **Molecular movement of electronic acceptor-doped coal and its interaction with solvent.: Change of intermolecular cohesion in coal by heat treatment.** Sasaki, M. (Government Industrial Development Laboratory, Hokkaido, Sapporo (Japan)); Nagaishi, H.; Kotanigawa, T.; Kumagai, H.; Sanada, Y. 22 Jul 1992. 320p. (In Japanese). From 1. meeting of The Japan Institute of Energy and the 70th Foundation anniversary meeting; Tokyo (Japan); 22-24 Jul 1992. In *Proceedings of the 1st Meeting of the Japan Institute of Energy and the 70th Foundation Anniversary Meeting.* Order Number DE93793523. Source: OSTI; NTIS (US Sales Only).

From the solvent swelling phenomenon at room temperature, study was made of how the bridge formation and other intermolecular cohesions by the covalent bonding in coal structure change in the heating process. The swelling velocity of coal by solvent was judged to be influenced by the resisting action based on the coal structure (bridge formation, etc.) against the diffusion of solvent molecules. Therefore, the swelling velocity was taken notice of. Coal treated at 420 centigrade was lower in initial swelling velocity than raw coal. It was because the proceeding of thermal decomposition and polymerization of coal by the heat treatment at 420 centigrade increased the number of bridges formed by the covalent bonding and consequently intensified the obstruction to the diffusion of solvent molecules. On the other hand, coal treated at 300 centigrade was higher in initial swelling velocity than raw coal. It was judged to be because without proceeding of chemical reaction at 300 centigrade, the obstruction to the diffusion was loosened as the intermolecular cohesions by the others than the covalent bonding were destroyed by heat. The coal treated at 300 centigrade was higher in equilibrated degree of swelling than the raw coal, which was caused by the difference in initial swelling velocity. The equilibrated degree of swelling seems to be predictable from the initial swelling velocity. 1 ref., 2 figs.

22733 (CONF-9207203–, pp. 80-81) **Empirical evalution of affinity between macromolecular strucutre of coal and penetrating molecule.** Aida, T. (Kinki University, Osaka (Japan). Faculty of Engineering in Kyushu); Suzuki, S.; Yamawaki, N.; Fujii, M.; Yoshihara, M. 22 Jul 1992. 320p. (In Japanese). From 1. meeting of The Japan Institute of Energy and the 70th Foundation anniversary meeting; Tokyo (Japan); 22-24 Jul 1992. In *Proceedings of the 1st Meeting of the Japan Institute of Energy and the 70th Foundation Anniversary Meeting.* Order Number DE93793523. Source: OSTI; NTIS (US Sales Only).

Experimental studies were carried out with an objective to derive an equilibrium swelling value when extracting solvent solubles from coal. The coal used in the experiment was stored in nitrogen gas and depressurized and dried for three hours at 110°C before measurement. The organic solvent was dried and distilled. Relationship between concentrations of solutions in which butyl amine derivatives with different three-dimensional bulk heights are dissolved in methanol and the equilibrium swelling values was derived experimentally. The result showed that n-butyl amine with less steric hindrance showed a linear relationship, and tert-butyl amine with more steric hindrance had the swelling value depressed low in a single solution, but restored by adding methanol. Therefore, this was extrapolated where a latent swelling value was derived. The ratio of the equilibrium swelling values obtained for different solutions and reaction agents using dimethylformaldehide (DMF) as a reference solvent to the equilibrium swelling values of DMF alone was defined as a parameter to represent the affinity. 2 figs.

22734 (CONF-9207203–, pp. 86-91) **Studies on coal chemical structure based on combined data of solid state NMR spectroscopy and thermal pyrolysis.** Nomura, M. (Osaka University, Osaka (Japan). Faculty of Engineering); Murata, S.; Tajima, Y.; Nagasaka, N.; Adachi, N.; Nakamura, K. 22 Jul 1992. 320p. (In Japanese). From 1. meeting of The Japan Institute of Energy and the 70th Foundation anniversary meeting; Tokyo (Japan); 22-24 Jul 1992. In *Proceedings of the 1st Meeting of the Japan Institute of Energy and the 70th Foundation Anniversary Meeting.* Order Number DE93793523. Source: OSTI; NTIS (US Sales Only).

Unit chemical structure of Akabira coal was inferred using a solid state NMR and a pyrolysis. Its molecular weight was inferred to be 5765.15, and the composition formula was C383H372O38N6. The following problems surfaced during the inference work: (1) accurate measurement of molecular weights of extracts, (2) the Curie-point pyrolysis accompanying a large amount of caulking, (3) chemical bonds that link aromatics and their quantitative inference, and (4) quantification of CP/MAS ^{13}C-NMR spectra. This paper describes the molecular weight measurement in (1) and the inference on chemically bonded species in (3) by means of molecular weight measurement using light scattering method, and deuterization studies. The results of the light scattering measurement on coal extracts were 750,000 with AS, 900,000 with H-AS-1 and 660,000 with H-AS-2 for those hydrogenated under normal temperature. With regard to a Curie-point pyrolysis on HS and HI-BS, the experiment has not provided a definite result as to how the aromatic rings are linked when this method is used. 14 refs., 3 figs., 2 tabs.

22735 (DOE/PC/90284–10) **Molecular accessibility in solvent swelled coals: Quarterly report, May 1993.** Kispert, L.D. Alabama Univ., University, AL (United States). Dept. of Chemistry. 1993. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-90PC90284. Order Number DE93014975. Source: OSTI; NTIS; GPO Dep.

An EPR technique developed in this lab has been used to determine the pore size and number distribution changes after swelling the coal samples with various solvents. Stable nitroxide radical spin probes of different sizes, shapes and reactivity are dissolved in an appropriate solvent, the coal sample is then added to the resulting solution, stirred over night at elevated temperature, filtered, washed with a non swelling solvent to eliminate any spin probes that are not trapped in the pores and the spin concentration is measured. Comparing these spin probe measurements to DRIFT data have shown that the relative number distribution of acidic functionalities can be accurately predicted by the spin probe method. The spin probe method had also been used to predict the increase in elongated voids in Pittsburgh No. 8 (APCS No. 4) upon swelling with pyridine in agreement with independent SANS data. NMR relaxation data show that it is possible to deduce the pore (accessibility) distribution as a function of size (up to 6 nm). It has also been possible by variable temperature and ENDOR measurements to determine the presence of hydrogen bonding as a function of pore shape and size. The advantage of the EPR method is that it permits molecules of selected shape, size and reactivity to be used as probes of accessible regions of coal, thus providing information of importance to the diffusion and reactivity behavior of catalysts in coal.

22736 (DOE/PC/91302–6) **Hydrothermal reactions of fly ash: [Quarterly] report, January 1, 1993–March 31, 1993.** Brown, P.W. Pennsylvania State Univ., University Park, PA (United States). 1993. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-91PC91302. Order Number DE93014519. Source: OSTI; NTIS; GPO Dep.

The reactions which occur when fly ash is treated under hydrothermal conditions are being investigated. This is being done for two primary reasons. The first of these is to determine the nature of the phases that form, to assess the stabilities of these phases in the ambient environment and, finally, to assess whether these phases are capable of sequestering hazardous species. The second reason for undertaking this proposed study is that, depending on the composition of the ash and the presence of selected additives, it may be possible under hydrothermal conditions to form

compounds which have cementitious properties.Formation of four classes of compounds, which bracket likely fly ash compositional ranges, have been selected for study. These are calcium silicate hydrates, calcium silicosulfates, calcium aluminosulfates, andalkali aluminosilicates. The specific compounds fabricated will be determined and their stability regions assessed. As a part of stability assessment, the extent to which selected hazardous species are sequestered will be determined. Finally, the cementing properties of these compounds will be established.

22737 (DOE/PC/91305–5) **Characterization of porosity via secondary reactor: Quarterly technical progress report, 1 October 1992–31 December 1992.** Calo, J.M. Brown Univ., Providence, RI (United States). Div. of Engineering. 1992. 20p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-91PC91305. Order Number DE93014518. Source: OSTI; NTIS; GPO Dep.

In this quarterly technical Progress report, we summarize the progress which has been achieved with the development of the small angle scattering capability to be used in the current project. In particular, the following was accomplished during the reporting period. The parameter estimation code, MARQFIT, has been tested and is fully operational. The code has been applied to small angle neutron scattering (SANS) data on coals swollen with deuterated solvents. Application of the FPPS model to these data indicated that the large sphere distribution apparently requires a mean greater than 1000Å. This was attributed to the influence of interparticle voids. Specific surface areas were also estimated for these coals. Application of this model to the coal chars used in the current project will not be subject to the same effects.

22738 (DOE/PC/92521–T28) **Mass spectral study of organic sulfur in the polymeric matrix of coal: Technical report, December 1, 1992–February 28, 1993.** Hanley, L. (Illinois Inst. of Tech., Chicago, IL (United States). Dept. of Chemistry); Ho, K. Illinois Dept. of Energy and Natural Resources, Springfield, IL (United States). [1993]. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC22-92PC92521. Order Number DE93013647. Source: OSTI; NTIS; GPO Dep.

This report reviews the sixth quarter progress of a two year project to examine the chemical environment of organic sulfur in the polymeric matrix of Illinois coal by laser desorption ion trap mass spectrometry. This project is attempting to develop new laser desorption-ionization schemes for coal which preserve the polymeric matrix. During this quarter, we extended experiments utilizing ultraviolet matrix assisted laser desorption ionization to the examination of solvent extracts of coal. Regardless of the matrix compound, concentration, or laser wavelength chosen, only carbon cluster ions were observed in the mass spectra. During the next quarter, we will attempt to apply laser desorption of neutral compounds followed chemical ionization to form intact molecular ions from the polymeric component of coal.

22739 (DOE/PC/92544–2) **Vapor pressures and heats of vaporization of primary coal tars: Quarterly technical progress report, 1 October 1992–31 December 1992.** Suuberg, E.M. Brown Univ., Providence, RI (United States). Div. of Engineering. [1992]. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-92PC92544. Order Number DE93014958. Source: OSTI; NTIS; GPO Dep.

The vapor pressure correlations that now exist for coal tars are quite crude. Sophisticated general correlative approaches are slowly being developed, based upon group contribution methods, or based upon some key functional features of the molecules. These are as yet difficult to apply to coal tars. The detailed group contribution methods, in which fairly precise structural information is needed, do not lend themselves well for application. to very complex, poorly characterized coal tars. The methods based upon more global types of characterizations have not yet dealt much with the question of oxygenated functional groups. In short, only very limited correlations exist, and these are not considered reliable to even an order of magnitude when applied to tars. The present project seeks to address this important gap in the near term by direct measurement of vapor pressures of coal tar fractions, by application of well-established techniques and modifications thereof. The principal objectives of the program are to: (1) obtain data on the vapor pressures and heats of vaporization of tars from a range of ranks of coal, (2) develop correlations based on a minimum set of conveniently measurable characteristics of the tars, (3) develop equipment that would allow performing such measurements in a reliable, straightforward fashion.

0108 Waste Management

Refer also to citation(s) 22767, 23336

22740 (DOE/PC/92521–T2) **Microbial stabilization of sulfur-laden sorbents: Technical report, December 1, 1992–February 29, 1993.** Miller, K.W. (Illinois State Univ., Normal, IL (United States)); Banerjee, D. Illinois Dept. of Energy and Natural Resources, Springfield, IL (United States). 1993. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC22-92PC92521. Order Number DE93013620. Source: OSTI; NTIS; GPO Dep.

Clean coal technologies that involve limestone for in situ sulfur capture generate lime/limestone products laden with sulfur at various oxidation states. If sulfur is completely stabilized as sulfate, the spent sorbent is ready for commercial utilization as gypsum. However, the presence of reduced sulfur species requires additional processing. Thermal oxidation of reduced sulfur frequently results in undesirable release of SO_2. Microbial oxidation may provide an inexpensive and effective alternative. Sorbents laden with reduced forms of sulfur such as sulfide or sulfite can serve as growth substrates for sulfur-oxidizing bacteria, which convert all sulfur to sulfate. The goals of this project are to optimize conditions for sulfate generation from sulfide and sulfite on prepared lime/limestone mixtures; to test and optimize the effectiveness of microbial processing on spent sorbents from coal gasification, in-duct sorbent injection, and fluidized bed combustion; and to search for hyperalkalinophilic thiobacilli, which would be effective up to pH 11. We report here progress toward controlling the pH of culture media, and determining the highest pH at which several environmental isolates and named strains could initiate sulfur oxidation.

22741 (DOE/PC/92521–T3) **Recovery and utilization of gypsum and limestone from scrubber sludge: Technical report, December 1, 1992–February 28, 1993.** Kawatra, S.K. (Michigan Technological Univ., Houghton, MI (United States). Dept. of Metallurgical and Materials Engineering); Eisele, T.C.; Banerjee, D. Illinois Dept. of Energy and Natural Resources, Springfield, IL (United States). 1993. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC22-92PC92521. Order Number DE93013621. Source: OSTI; NTIS; GPO Dep.

Wet flue-gas desulfurization units in coal-fired power plants produce a large amount of sludge which must be disposed of, and which is currently landfilled in most cases. Increasing landfill costs are gradually forcing utilities to find other alternatives. In principle, this sludge can be used to make gypsum ($CaSO_4$-$2H_2O$) for products such as plaster-of-Paris and wallboard, but only if impurities such as unreacted limestone and soluble salts are removed, and the calcium sulfite ($CaSO_3$) is oxidized to calcium sulfate ($CaSO_4$). This project is investigating methods for removing the impurities from the sludge so that high-quality, salable gypsum products can be made. Work done in the previous quarter concentrated on developing a dependable technique for analysis of scrubber sludge, so that it would be possible to determine exactly how well a particular purification process was working. This technique was then used to characterize the sludge from a particular Illinois power station. In the current quarter, studies were carried out using froth flotation to produce a product that could be oxidized to high-purity gypsum. These experiments have been quite successful, due to certain properties of the limestone impurity that makes it easier to remove by this method than was expected.

0109 Environmental Aspects

Refer also to citation(s) 24649

22742 (ANL/EAIS/CP–79487) **Applying environmental externalities to US Clean Coal Technologies for Asia.** Szpunar, C.B.;

Gillette, J.L. Argonne National Lab., IL (United States). Environmental Assessment and Information Sciences Div. [1993]. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-930413–1: 18. international technical conference on coal utilization, slurry technologies and fuel systems, Clearwater, FL (United States), 26-29 Apr 1993). Order Number DE93012900. Source: OSTI; NTIS; INIS; GPO Dep.

The United States is well positioned to play an expanding role in meeting the energy technology demands of the Asian Pacific Basin, including Indonesia, Thailand, and the Republic of China (ROC-Taiwan). The US Department of Energy Clean Coal Technology (CCT) Demonstration Program provides a proving ground for innovative coal-related technologies that can be applied domestically and abroad. These innovative US CCTs are expected to satisfy increasingly stringent environmental requirements while substantially improving power generation efficiencies. They should also provide distinct advantages over conventional pulverized coal-fired combustors. Finally, they are expected to be competitive with other energy options currently being considered in the region. This paper presents potential technology scenarios for Indonesia, Thailand, and the ROC-Taiwan and considers an environmental cost-benefit approach employing a newly developed method of applying environmental externalities. Results suggest that the economic benefits from increased emission control can indeed be quantified and used in cost-benefit comparisons, and that US CCTs can be very cost effective in reducing emissions.

22743 (INIS-mf–13519) **Ecological stability of landscape - ecological infrastructure - ecological management.** Federal Committee for Environment, Prague (Czech Republic); Institute of Applied Ecology, Kostelec nad Cernymi Lesy (Czech Republic). 1992. [153p.] (CONF-9206363–: Field workshop on ecological stability of landscape, ecological infrastructure and ecological management, Kostelec nad Cernymi Lesy (Czechoslovakia), 15-20 Jun 1992). Order Number DE93624591. Source: OSTI; NTIS (US Sales Only); INIS.

The Field Workshop 'Ecological Stability of Landscape - Ecological Infrastructure - Ecological Management' was held within a State Environmental Programme financed by the Federal Committee for the Environment. The objectives of the workshop were to present Czech and Slovak approaches to the ecological stability of the landscape by means of examples of some case studies in the field, and to exchange ideas, theoretical knowledge and practical experience on implementing the concept of ecological infrastructure in landscape management. Out of 19 papers contained in the proceedings, 3 items were inputted to the INIS system. (Z.S.).

22744 (INIS-mf–13519, pp. 125-130) **Restoration of territorial system of ecological stability in the North-Bohemian brown coal basin.** Stys, S. (ECOCONSULT Ltd. Most (Czechoslovakia)). Federal Committee for Environment, Prague (Czech Republic); Institute of Applied Ecology, Kostelec nad Cernymi Lesy (Czech Republic). 1992. (CONF-9206363–: Field workshop on ecological stability of landscape, ecological infrastructure and ecological management, Kostelec nad Cernymi Lesy (Czechoslovakia), 15-20 Jun 1992). In *Proceedings of the field workshop on ecological stability of landscape, ecological infrastructure and ecological management.* [153p.] Order Number DE93624591. Source: OSTI; NTIS (US Sales Only); INIS.

Natural and socio-economic factors and technological procedures are discussed in restoring the North Bohemian brown coal basin area affected by mining. Some results are presented of restoration activities carried out systematically since 1952. At the end of 1991 the whole basin reclamation was completed on 6409.23 ha and uncompleted on 3096.89 ha. At present, long-term reclamation plans are under preparation with a time horizon of 2030 when the mining activity is supposed cease. (Z.S.) 1 tab.

22745 (INIS-mf–13519, pp. 100-103) **Spoil heaps from brown-coal mining in NW Bohemia: spontaneous succession vs reclamation.** Prach, K. (Czechoslovak Academy of Sciences, Trebon (Czechoslovakia). University of South Bohemia and Institute of Botany). Federal Committee for Environment, Prague (Czech Republic); Institute of Applied Ecology, Kostelec nad Cernymi Lesy (Czech Republic). 1992. (CONF-9206363–: Field workshop on ecological stability of landscape, ecological infrastructure and ecological management, Kostelec nad Cernymi Lesy (Czechoslovakia), 15-20 Jun 1992). In *Proceedings of the field workshop on ecological stability of landscape, ecological infrastructure and ecological management.* [153p.] Order Number DE93624591. Source: OSTI; NTIS (US Sales Only); INIS.

Some results, conclusions and suggestions are presented that emerged from the study on spontaneous succession which started in 1977. Trends in spontaneous succession are briefly described. Under certain conditions, spontaneous succession is the cheapest reclamation method. On marginal heap slopes, tree planting is recommended as the most rapid reclamation measure. The expansion of grasses and trees can be accelerated by their artificial sowing or planting. Arrhena therum elatius seems to be the most suitable among grasses, and Betula verrucosa among woody species to be sown and then successfully established. The best time is usually between the 6th and 10th years of spontaneous succession. (Z.S.) 1 fig., 4 refs.

22746 (INIS-mf–13519, pp. 104-107) **Different approaches to the afforestation of damaged areas in the Ore Mountains.** Tichy, J. (J. E. Purkyne University, Usti nad Labem (Czechoslovakia)). Federal Committee for Environment, Prague (Czech Republic); Institute of Applied Ecology, Kostelec nad Cernymi Lesy (Czech Republic). 1992. (CONF-9206363–: Field workshop on ecological stability of landscape, ecological infrastructure and ecological management, Kostelec nad Cernymi Lesy (Czechoslovakia), 15-20 Jun 1992). In *Proceedings of the field workshop on ecological stability of landscape, ecological infrastructure and ecological management.* [153p.] Order Number DE93624591. Source: OSTI; NTIS (US Sales Only); INIS.

Two approaches are presented to the afforestation of damaged areas, i.e., the concept based on introduction of species and that based on use of pioneer species. Natural succession is a less risky way of afforestation for the localities most damaged by air pollution; directed succession is probably the fastest way to reach the climax composition of species again. Liming and fertilizing should not be used schematically. Their use prior to planting or sowing is recommended. (Z.S.) 1 fig., 5 refs.

0110 Reserves, Geology, and Exploration

Refer also to citation(s) 22854

0120 Mining

22747 (ETDE-mf–93795644) **Report on the activities of the mining authorities in the Land North-Rhine Westphalia in 1991.** Ministerium fuer Wirtschaft, Mittelstand und Technologie des Landes Nordrhein-Westfalen, Duesseldorf (Germany). 1992. 96p. (In German). Order Number DE93795644. Source: OSTI; NTIS (US Sales Only).

A survey of the economic situation of individual branches of the mining industry and the structure and responsibility of the mining authorities is followed by a description of the activities in the fields of mining technology and safety, work safety, health protection and environment. (HS).

0130 Transport, Handling, and Storage

22748 (CONF-9207203–, pp. 101-104) **Demonstration test of coal-water slurry fuel.** Onaka, A. (Ube Industries, Ltd., Yamaguchi (Japan)); Wada, T.; Sawada, M.; Umitsu, A.; Nakai, S. 22 Jul 1992. 320p. (In Japanese). From 1. meeting of The Japan Institute of Energy and the 70th Foundation anniversary meeting; Tokyo (Japan); 22-24 Jul 1992. In *Proceedings of the 1st Meeting of the Japan Institute of Energy and the 70th Foundation Anniversary Meeting.* Order Number DE93793523. Source: OSTI; NTIS (US Sales Only).

A demonstration test of slurry fuel was conducted for possible practical use of high-concentration coal-water slurry (CWM). A total system was structured for this demonstration test from CWM manufacture to storage and transportation, and to combustion. It was verified that in the manufacturing test the filling performance of coal particles that governs raising of CWM concentration is nearly

the same as in the pilot facility and variations in pulverability and other properties due to coal types can be coped with. In the storage and transportation test, it was proved that the fuel can be handled as for heavy oil, including repetition of long-term storage, receiving and delivery. The combustion test indicated that when CWM exclusive burning using standard coal is compared with coal/heavy oil mixture burning, NOx emission was slightly higher and the combustion efficiency was somewhat worse, but the differences were not large. Difference due to grain sizes of coal particles was also relatively small. Dust collecting performance was better than the coal/heavy oil burning. Load followability was as good as oil burning boilers. 2 refs., 3 figs., 3 tabs.

22749 (CONF-9207203–, pp. 105-108) **Study of slurryability.** Suetsugu, K. (Ube Industries Ltd., Yamaguchi (Japan)); Sawada, M.; Sawamura, Y.; Nakai, S. 22 Jul 1992. 320p. (In Japanese). From 1. meeting of The Japan Institute of Energy and the 70th Foundation anniversary meeting; Tokyo (Japan); 22-24 Jul 1992. In *Proceedings of the 1st Meeting of the Japan Institute of Energy and the 70th Foundation Anniversary Meeting.* Order Number DE93793523. Source: OSTI; NTIS (US Sales Only).

Comparisons and discussions were given on coal-water slurries made by dry and wet manufacturing processes as to their slurryability. The dry-method slurries were manufactured by dry-pulverizing four types of coal to make five test samples having different grain size distributions according to each type of coal, added with water, dispersant, and pH adjusting agent. The wet-method slurries were manufactured by pulverizing coals to 3 mm under, and charging them into a batch mill with water, dispersant, and pH adjusting agent to mix them in a wet condition. When the dry-method and wet-method slurries were prepared in a laboratory, the dry-method slurries were possible of raising the concentration higher than that for the wet-method slurries even in samples having identical grain size distribution. A cause for this difference could be ash suspended in the slurries affecting the slurryability. However, this difference in slurryability is not caused simply from amount of free ash, but chemical compositions and suspending conditions of the free ash, which may affect the fluid characteristics of the slurries and work as an apparent impeding factor for raising the concentration. 2 refs., 7 figs., 2 tabs.

22750 (OCDO–93013795) **A novel coal feeder system: Final report.** Keener, T.C. (Cincinnati Univ., OH (United States). Dept. of Civil and Environmental Engineering). Ohio Coal Development Office, Columbus, OH (United States); Cincinnati Univ., OH (United States). Dept. of Civil and Environmental Engineering. 14 Jan 1991. 68p. Sponsored by Ohio State Government, Columbus, OH (United States). Source: OSTI; Ohio Coal Development Office, 77 S. High Street, Box 1001, Columbus, OH 43266-0001.

A novel coal feeder system has undergone testing and evaluation at the University of Cincinnati. The system consists primarily of an auger feed tube which is used to both convey and provide desulfurization of a high sulfur coal feedstock. The coal is conveyed at temperatures ranging from 350 to 550°C and under normal atmospheric pressure. Under these mild processing conditions, the coal partially pyrolizes and emits sulfur in the form of hydrogen sulfide while maintaining a relatively high heating value in the char product ne evolved gases are evacuated from the reactor (the feed tube) to another absorbing bed where H_2S reacts with the sorbent, usually lime or limestone. The result sorbent utilization substantially higher than the values found in current dry scrubbing system and the produced low-sulfur char may then be used in a conventional steam boiler. The current experimental results revealed that at a low temperature (375°C) fractional devolatilization of an Ohio #8 coal increases linearly with increasing residence time while fractional desulfurization approaches an exponential maximum value of about 32 percent as residence time goes to infinity. When desulfurization reaches to 30 percent at 8 minutes residence time, the devolatilization is only about 5 percent (mass basis). This implies that longer residence time may not necessarily produce desirable fuel products in terms of sulfur loss vs. heat value loss. A problem encountered in this research is the tendency of the coal to swell and become sticky at temperatures above 450°C (this is true for all non-caking coals). Methods to eliminate this problem are currently being investigated under a grant from the US Department of Energy.

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Refer also to citation(s) 22691, 22748, 23327, 23330, 23337, 23914, 24246, 24469

22751 (CONF-9207203–, pp. 109-110) **Emissions of NOx and N2O from a circulating fluidized bed combustor.** Shimizu, T. (Niigata University, Niigata (Japan). Faculty of Engineering); Tachiyama, T.; Wakayama, O.; Fujita, D.; Kumazawa, K.; Inagaki, M. 22 Jul 1992. 320p. (In Japanese). From 1. meeting of The Japan Institute of Energy and the 70th Foundation anniversary meeting; Tokyo (Japan); 22-24 Jul 1992. In *Proceedings of the 1st Meeting of the Japan Institute of Energy and the 70th Foundation Anniversary Meeting.* Order Number DE93793523. Source: OSTI; NTIS (US Sales Only).

Three types of coal with different volatility were used to evaluate effects of limestone charged into a coal circulating fluidized bed combustor on emission of NOx and N2O. The limestone is the one produced in Chichibu, Japan (CaCO3 content at 96.3% and size from 0.25 mm to 0.35 mm), and supplied into the combuster using impulse charging and continuous charging methods. As the limestone is charged, SO2 concentration decreases (desulfurization rate increases), when N2O emission dropped and NOx emission rose. Results of impulse charging and continuous supply agreed well with each other. The N2O and NOx emission depends on desulfurizing activity of the limestone in a furnace, and is not affected by the supply systems. The N2O emission was decreased by about 10% to 30%. The more the volatile components the coal has, the more the N2O reduction effect. However, no distinctive volatility dependence was observed with regard to the increase rate of NOx. 5 refs., 2 figs., 1 tab.

22752 (DOE/FTR–93013018) **[Travel to Australia to attend the 24th international symposium on combustion at the University of Sydney]: Foreign trip report, June 29–July 19, 1992.** Hurt, R.H. Sandia National Labs., Livermore, CA (United States). 12 Aug 1992. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DR00789. Order Number DE93013018. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report summarizes the proceedings of the 24th Combustion Symposium in Sydney, Australia relevant to DOE/FE programs. Also summarized are technical exchanges during site visits to (1) The Newcastle Laboratories of BHP Co., hosted by Dr. John Truelove; (2) Lucas Heights Research Laboratories of the CSIRO, hosted by Dr. David Death and Dr. John Eberhard; (3) the coal combustion research group of Professor Terry Wall, Chemical Engineering Department of the University of Newcastle; (4) The Division of Coal and Energy Technology of the CSIRO at the North Ryde Research Laboratories, hosted by Dr. David Harris.

22753 (DOE/FTR–93013555) **[Travel to Trondheim, Norway to participate in the IEA task leaders meeting]: Foreign trip report, June 20–27, 1992.** Marx, K.D.; Carling, R.W. Sandia National Labs., Livermore, CA (United States). 14 Aug 1992. 18p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DR00789. Order Number DE93013555. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The meeting was attended by approximately 43 people from 10 countries. This includes 15 attendees from Norway, the host country. The technical sessions, comprised of 39 papers, were held on Monday–Wednesday, June 22–24. Thursday morning, June 25, was devoted to a tour of Marintek, the Marine Technology Center at the Norwegian Institute of Technology. The IEA Executive Committee meeting was held on Friday, June 26. The entire trip, including travel to and from Trondheim, extended from June 20 through June 27. An itinerary, a meeting agenda, and a list of attendees are attached.

22754 (DOE/MC/10637–3313) **EERC pilot-scale CFBC evaluation facility Project CFB test results: Topical report, Task 7.30.** Mann, M.D.; Hajicek, D.R.; Henderson, A.K.; Moe, T.A. North Dakota Univ., Grand Forks, ND (United States). Energy and Environmental Research Center. Sep 1992. 360p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC21-86MC10637. Order Number DE93000253. Source: OSTI; NTIS; GPO Dep.

Project CFB was initiated at the University of North Dakota Energy and Environmental Research Center (EERC) in May 1988. Specific goals of the project were to (1) construct a circulating fluidized-bed combustor (CFBC) facility representative of the major boiler vendors' designs with the capability of producing scalable data, (2) develop a database for use in making future evaluations of CFBC technology, and (3) provide a facility for evaluating fuels, free of vendor bias for use in the - energy industry. Five coals were test-burned in the 1-MWth unit: North Dakota and Asian lignites, a Wyoming subbituminous, and Colorado and Pennsylvania bituminous coats. A total of 54 steady-state test periods were conducted, with the key test parameters being the average combustor temperature, excess air, superficial gas velocity, calcium-to-sulfur molar ratio, and the primary air-to-secondary air split. The capture for a coal fired in a CFBC is primarily dependent upon the total alkali-to-sulfur ratio. The required alkali-to ratio for 90% sulfur retention ranged from 1.4 to 4.9, depending upon coal type. While an alkali-to-ratio of 4.9 was required to meet 90% sulfur retention for the Salt Creek coal versus 1.4 for the Asian lignite, the total amount of sorbent addition required is much less for the Salt Creek coal, 4.2 pound sorbent per million Btu coal input, versus 62 pound/million Btu for the Asian lignite. The bituminous coals tested show optimal capture at combustor temperatures of approximately 1550°F, with low-rank coals having optimal sulfur capture approximately 100°F lower.

22755 (DOE/MC/23166–3320) **Advanced coal-fueled industrial cogeneration gas turbine system: Annual report, June 1991–June 1992.** LeCren, R.T.; Cowell, L.H.; Galica, M.A.; Stephenson, M.D.; When, C.S. Solar Turbines, Inc., San Diego, CA (United States). Jun 1992. 83p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC21-86MC23166. Order Number DE93000256. Source: OSTI; NTIS; GPO Dep.

This report covers the activity during the period from 2 June 1991 to 1 June 1992. The major areas of work include: the combustor sub-scale and full size testing, cleanup, coal fuel specification and processing, the Hot End Simulation rig and design of the engine parts required for use with the coal-fueled combustor island. To date Solar has demonstrated: Stable and efficient combustion burning coal-water mixtures using the Two Stage Slagging Combustor; Molten slag removal of over 97% using the slagging primary and the particulate removal impact separator; and on-site preparation of CWM is feasible. During the past year the following tasks were completed: The feasibility of on-site CWM preparation was demonstrated on the subscale TSSC. A water-cooled impactor was evaluated on the subscale TSSC; three tests were completed on the full size TSSC, the last one incorporating the PRIS; a total of 27 hours of operation on CWM at design temperature were accumulated using candle filters supplied by Refraction through Industrial Pump & Filter; a target fuel specification was established and a fuel cost model developed which can identify sensitivities of specification parameters; analyses of the effects of slag on refractory materials were conducted; and modifications continued on the Hot End Simulation Rig to allow extended test times.

22756 (DOE/MC/24132–93/C0187) **Tidd PFBC Demonstration Plant operation and testing.** Marrocco, M.; Hafer, D.R. American Electric Power Service Corp., Columbus, OH (United States). [1993]. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC21-87MC24132. (CONF-9303154–1: Air and waste water management seminar, New Orleans, LA (United States), 9-12 Mar 1993). Order Number DE93012830. Source: OSTI; NTIS; GPO Dep.

The Tidd PFBC Demonstration Plant, located in Brilliant, Ohio, is in its third year of operation and testing. The plant has achieved many of its original performance goals and test objectives; however, current emissions standards and the projected performance of competing technologies have caused a reassessment of the program goals. This paper provides a review of PFBC technology and discusses project goals and milestones achieved. Emphasis is placed on environmental performance and on projected modifications to be undertaken to improve sulfur capture and reduce calcium/sulfur molar ratio. A large-scale hot gas clean up demonstration is also in progress at Tidd. The demonstration has been providing information on ceramic barrier filter technology since its commissioning in October 1992. The Tidd Plant has met both its performance guarantees for emissions and its environmental permit limits. However, the tightening of government environmental standards and the projected performance of competing technologies have required a reassessment of the goals of AEP's PFBC program. Efforts are focusing on achieving better environmental performance, particularly with respect to sulfur capture and sorbent utilization.

22757 (DOE/MC/24132–3359) **Tidd PFBC Demonstration Project fourth quarterly technical progress report, CY 1992.** American Electric Power Service Corp., Columbus, OH (United States). Jan 1993. 33p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC21-87MC24132. Order Number DE93014529. Source: OSTI; NTIS; GPO Dep.

This is the 23rd technical progress report submitted to the Department of Energy in connection with the cooperative agreement between the DOE and the Ohio Power Company for the Tidd PFBC Demonstration Plant. This report covers the period from October 1, 1992 to December 31, 1992. Major activities during this period involve: (1) The unit was operated for a total of 714 hours (including gas turbine air prewarming). There were seven gas turbine starts, seven bed preheater starts, and seven operating periods with coal fire. The peak gross output of 64 MWH was achieved for the period of 1000 to 1100 hours on November 23, 1992. The longest coal fire was 285 hours beginning at 1211 hours on November 25, 1992. (2) Total gross generation was 24,643, and coal consumption was 11,900 tons. (3) The hot gas clean up system was commissioned. (4) Active end fluidization system to address sparge duct cracking and deformation problem was jointly initiated by ABB carbon, B&W and AEPSC. (5) All testing continued using Plum Run dolomite. This approach was taken as a conservative means to avoid sintering and unit trips which were encountered during the previous two start-ups in September using limestone and (6) monitoring of solid, liquid and gaseous waste streams, as detailed in the operations phase monitoring requirements in the EMP, were performed.

22758 (DOE/MC/24258–3362) **Testing of electrostatic agglomerator: Second quarterly report, May–July 1988.** Quimby, J. Cottrell Environmental Sciences, Somerville, NJ (United States). [1988]. 20p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC21-88MC24258. Order Number DE93013993. Source: OSTI; NTIS; GPO Dep.

The ESA combustor has been redesigned for higher thermal inputs to alleviate problems due to poor CWM atomization, poor mixing, low Reynolds numbers, long ESA heatup times and high heat losses. A thermal analysis of the ESA has been made in order to estimate heatup times. Precipitator designs have been completed.

22759 (DOE/MC/25048–3102) **Collaborative research on fluidization employing computer-aided particle tracking: Final report.** Chen, M.M. Illinois Univ., Urbana, IL (United States). Dept. of Mechanical and Industrial Engineering. Apr 1993. 142p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC21-88MC25048. Order Number DE93000274. Source: OSTI; NTIS; GPO Dep.

Discussions presented in this report highlight all the important considerations for making particle dynamics measurements using the radioactive active particle tracking methodology. It is seen that the technique makes it possible to obtain data which are not accessible by any other means. Among the advantages of the methods are: (1) It is completely uninvasive, and hence cannot disturb the flow. (2) It can penetrate opaque suspensions. (3) It yields detailed, spatially resolved (subject to resolution limitations) data on mean velocity and density distributions as well as other statistical quantities. Its disadvantages are: (1) It can only provide time averaged data. It cannot provide instantaneous "snap shots" of the flow field. (2) It cannot yield information of flows around bubbles, which are of great interest in fluidization theories. (3) It has only modest resolution – of the order of a two to four percent of the flow field. However, the resolution can be improved by almost an order of magnitude, if long test runs can be used to acquire data of high statistical quality. 4. For data of adequate resolution, long test runs – several hours and up - are needed. Clearly if used with a clear understanding of its capabilities as well as limitations,

the radioactive particle tracking technique can make possible measurements which are not possible by any other method, and contribute significantly to the study of suspension flows.

22760 (DOE/MC/27364–93/C0186) **Process performance of Ahlstrom Pyroflow PCFB pilot plant.** Sellakumar, K.M. (R&D Center, Ahlstrom Pyropower, Inc., San Diego, CA (United States)); Isaksson, J.; Tiensuu, J. Midwest Power, Des Moines, IA (United States). May 1993. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC21-91MC27364. (CONF-930521–7: 12. international conference on fluidized-bed combustion, San Diego, CA (United States), 8-13 May 1993). Order Number DE93011584. Source: OSTI; NTIS; GPO Dep.

Ahlstrom Pyropower has designed and built a 10 MW_{th} (34 MMBtu) pressurized circulating fluidized bed (PCFB) pilot plant in Karhula, Finland. The unit is now operating. Data from this unit supports the design of a nominal 80 MW, Des Moines Energy Center 1 (DMEC-1) PCFB Repowering Project. The pilot plant PCFB combustor is of square cross-section. It is housed in a 3.6 m (11.8 ft) diameter pressure vessel. A high pressure high temperature gas cleaning unit downstream of the PCFB exhaust is installed in a separate 2.6 m (8.5 ft) diameter pressure vessel. The maximum plant operating pressure is 16 bar (232 psia). The fuel is fed in slurry form; sorbent is also fed along with the fuel. The net heat input per unit cross section of the combustor is the highest of any known combustion mode. The heat release can go up to 40 MW/m^2 (12.6 MMBtu/ft^2 hr). Many types of coals including high sulfur, bituminous Illinois No. 6 coal and Western sub bituminous, low sulfur Powder River Basin coal were tested. Combustion efficiencies in the range of 99.5 to 99.9% have been consistently observed. Emissions of various gases such as NO_x SO_2 and CO at different operating pressures and loads were monitored. The gas emissions have been lower than expected based on atmospheric circulating fluidized bed boiler experience. The sulfur retention is over 95 % with a Ca/S molar ratio of 1 to 2 for high sulfur Illinois No.6 coal. A GAVS molar ratio of 2.5 to 3.5 was observed to retain 95 % of sulfur with low sulfur Powder River Basin coal. All gaseous emissions during testing with Illinois No. 6 coal and Powder River Basin coal are well within the projected limits for the DMEC1 project. Emission data from tests with Illinois No. 6 coal and Powder River Basin coal are presented in the paper.

22761 (DOE/METC/C–93/7062) **Second-generation pressurized fluidized bed combustion plants for electric power generation.** Robertson, A. (Foster Wheeler Development Corp., Livingston, NJ (United States)); Bonk, D.; Horazak, D.; Newby, R.; Rehmat, A. USDOE Morgantown Energy Technology Center, WV (United States). [1992]. 18p. Sponsored by USDOE, Washington, DC (United States). (CONF-921115–1: 5. international power generation industries conference and exposition, Orlando, FL (United States), 17-19 Nov 1992). Order Number DE93011586. Source: OSTI; NTIS; GPO Dep.

In the search for a more efficient, less costly, and more environmentally responsible method for generating electrical power from coal, research and development has turned to advanced pressurized fluidized bed combustion (PFBC) and coal gasification technologies. A logical extension of this work is the second-generation PFBC plant, which incorporates key components of each of these technologies. In this new type of plant, coal is devolatilized/carbonized before it is injected into the PFB combustor bed, and the low-Btu fuel gas produced by this process is burned in a gas turbine topping combustor. By integrating coal carbonization with PFB°C (2300°F) and higher can be achieved. When integrated with a conventional 16.5-MPa gage/538°C/538°C/8.5-kPa Hg (2400- psig/1000°F/1000°F/2.5-in. Hg) steam cycle, a plant electrical generating efficiency of 45-percent is predicted. Concomitant advantages, among others, are a 20-percent lower cost of electricity (compared with a conventional pulverized-coal-fired plant with stack gas scrubbing), reduced stack emissions, and components that can be shipped by barge. This paper presents a conceptual design and economic analysis of Pittsburgh No. 8 and Texas lignite coal-fired 500-MWe second-generation PFB combustion plants.

22762 (DOE/PC/79660–T10) **Development of a vortex combustor (VC) for space/water heating applications (combustion tests): Final report.** Fu, T.T. (Naval Civil Engineering Lab., Port Hueneme, CA (United States)); Nieh, S. Naval Civil Engineering Lab., Port Hueneme, CA (United States). Nov 1990. 124p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AI22-87PC79660. Order Number DE93013059. Source: OSTI; NTIS; GPO Dep.

This is the final report for Interagency Agreement DE-AI22-87PC79660 on "Combustion Test" for vortex combustor (VC) development for commercial applications. The work culminated in the successful demonstration of a 2 MB/H proof-of-concept (POC) model firing coal-water fuel (CWF). This development is concerned with a new concept in combustion, and was a general lack of relevant information. The work therefore began (in addition to the companion cold flow modeling study) with the design and test of two subscale models (0.15 and 0.3 MB/H) and one full scale model (3 MB/H) to obtain the needed information. With the experience gained, the 2 MB/H POC model was then designed and demonstrated. Although, these models were designed somewhat differently from one another, they all performed well and demonstrated the superiority of the concept. In summary, test results have shown that VC can be fired on several coal fuels (CWF, dry ultrafine coal, utility grind pulverized coal) at high combustion efficiency (>99%), high firing intensity (up to 0.44 MB/H-ft^3), and at temperatures sufficiently low or dry ash removal. The combustion process is completed totally inside the combustor. Conventional combustion enhancement techniques such as: preheating (air and/or fuel), pre-combustion, and post combustion are not needed.

22763 (DOE/PC/90310–T11) **Combustion of dense streams of coal particles: Quarterly progress report No. 10, November 29, 1992–February 28, 1993.** Annamalai, K. Texas A and M Univ., College Station, TX (United States). Dept. of Mechanical Engineering. 1993. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-90PC90310. Order Number DE93014943. Source: OSTI; NTIS; GPO Dep.

This progress report defines Tasks For November 29, 1992 to February 28, 1993. Continue the parametric experiments on stream combustion: (i) cloud denseness, (ii) particle size, (iii) gas temperature, (iv) residence time, and (v) oxygen concentration. Mr. Gopalakrishnan is expected to defend his MS Thesis by May 1993. The MS Thesis of Mr.Gopalakrishnan and a part of the Ph.D Thesis of Mr. Du and Dr. William Ryan will constitute the final report on the project. Activities During November 29, 1992 to February 28, 1993. Attempts have been made on direct measurement of the velocity of particles using imaging technology (Appendix A). The status of the tasks is given in Table I (Appendix B). The effects of cloud denseness (A:F ratio in the stream) and residence time (zone height) on the burnt fraction are given in Figures 1 and 2 (Appendix B). The A:F ratio of 1:1 is equivalent to 7×10^9 particle per m^3 or ℓ/a = 16. Detailed video-images have been obtained which are expected to yield the luminosity contours and stream diameters. However, analyses of the images have not yet been completed. The computer code for combustion of spherical clouds has been used to model the combustion of a large porous coal particle because of the strong analogy between the combustion of clouds and a porous coal particle. The model was first used for generating results on heterogeneous and homogeneous ignition of coal particles assuming uniform particle temperature. The transient results indicate heterogeneous ignition first followed by homogeneous ignition and combustion at later times. Large particle starts with homogeneous ignition. Further transient results differ from quasi-steady results of Wall, et al of Australia.

22764 (DOE/PC/90547–T10) **Evaluation of gas-reburning and low NO_x burners on a wall fired boiler: Technical progress report No. 10, January 1–March 31, 1993.** Energy and Environmental Research Corp., Irvine, CA (United States). 15 Apr 1993. 16p. Sponsored by USDOE, Washington, DC (United States); Electric Power Research Inst., Palo Alto, CA (United States); Gas Research Inst., Chicago, IL (United States). DOE Contract FC22-91PC90547. Order Number DE93014514. Source: OSTI; NTIS; GPO Dep.

Clean Coal Technology (CCT) implies the use of coal in an environmentally acceptable manner. Coal combustion results in the emission of oxides of nitrogen (NO_x), which are precursors of both

acid rainand ozone formation. The primary objective of this CCT project is to evaluate the use of Gas Reburning and Low NO_x Burners (GR-LNB) for NO_x emission control from a wall fired boiler. It is anticipated that, if the demonstration is successful, the GR-LNB technology could become commercialized during the 1990's and will be capable of (1) achieving significant reduction in the emissions of nitrogen oxides and sulfur dioxide (another acid rain precursor) from existing facilities to minimize environmental impacts such as transboundary and interstate pollution and/or (2) providing for future energy needs in an environmentally acceptable manner. Low NO_x burners are designed to delay the mixing of the coal fuel with combustion air to minimize the NO_x formation. Typically, one may obtain up to 50% reduction in NO_x emissions through the use of LNB. For LNB applications, the technology is developed and a number of LNB designs are commercially available. With GR, about 80–85 percent of the coal fuel is fired in the main combustion zone. The balance of the fuel is added downstream as natural gas to create a slightly fuel rich environment in which NO_x, is converted to N_2. The combustion process is completed by over-fire air addition. SO_x emissions are reduced to the extent that natural gas replaces sulfur-containing coal. The level of NO_x reduction achievable with 15–20% natural gas is on the order of 50–60 %. Thus the emission reduction target of the combination of these two developed technologies is about 75%.

22765 (DOE/PC/91284–2) **Nitration of polynuclear aromatic hydrocarbons in coal combustors and exhaust streams: Quarterly report, January 1, 1992–March 31, 1992.** Yu, L.; Dadamio, J.; Hildemann, L.; Niska, S. Stanford Univ., CA (United States). Dept. of Civil Engineering. Dec 1992. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-91PC91284. Order Number DE93014957. Source: OSTI; NTIS; GPO Dep.

Regarding PAH preparation, our efforts this quarter were directed at identifying the operating conditions in the laboratory furnace that clearly resolve primary devolatilization from secondary pyrolysis. In previous studies, pristine tars from primary devolatilization were prepared in the radiant coal flow experiment with a furnace length of only 5 cm. Tars at various extents of secondary pyrolysis were generated in a hot-zone of 12.5 cm. For this project we decided to try to prepare both kinds of PAH in the 12.5 cm hot zone. Preliminary screening surveys showed that, among the dime possible ways to compensate for the longer furnace tube, only lowering the fumace temperature is really effective. Lowering the loading from its already low value of 300 No./cm^3 is inconsequential, and raising the gas velocity to lower residence times in the longer hot zones causes deposition problems. The coal jet undergoes the transition to turbulence in less than 12 cm for entrainment velocities greater than 1 cm/s. By the end of the quarter, it was clear that the best value for primary devolatilization studies will fall within the range of 1 150 to 1400 K. But at present we are still not completely satisfied with the resolution of primary devolatilization. As intended, the tars collected at short residence times are completely soluble in tetrahydrofuran (THF), indicating that no soot is present so no secondary pyrolysis has occurred. But at residence times long enough to attain ultimate primary devolatilization yields, some soot is present. We will make our final choice early in the next quarter, then begin to collect an inventory of primary devoatilization tars for subsequent detailed characterization.

22766 (DOE/PC/91292–T6) **Rheological properties essential for the atomization of coal water slurries (CWS): Quarterly progress report, December 15, 1992–March 15, 1993.** Ohene, F. Grambling State Univ., LA (United States). Dept. of Chemistry. 1993. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-91PC91292. Order Number DE93014516. Source: OSTI; NTIS; GPO Dep.

The overall objective of this project is to perform experiments to understand the effect of high shear and extensional properties on the atomization of coal-water slurries (CWS). In the atomization studies, the mean drop size of the CWS sprays will be determined at various air-to CWS. A correlation between the extensional and high shear properties, particle size distributions and the atomization will be made in order to determine the influence of these parameters on the atomization of CWS. During this past quarter, an attempt was made to establish a theoretical relationship between the sauter mean diameter, (SMD), theAir/Fuel ratio and the viscosity. Also the effect of polymeric additives on the rheology of glycerol was studied.

22767 (DOE/PC/92521–T4) **Geochemistry of FBC waste-coal slurry solid mixtures: Technical report, December 1, 1992–February 28, 1993.** Dreher, G.B. (Illinois Dept. of Energy and Natural Resources, Springfield, IL (United States). Geological Survey); Roy, W.R.; Steele, J.D.; Heidari, M.; Banerjee, D. Illinois Dept. of Energy and Natural Resources, Springfield, IL (United States). 1993. 21p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC22-92PC92521. Order Number DE93013622. Source: OSTI; NTIS; GPO Dep.

Three tasks are being conducted in this research project. All are related to understanding the chemistry and mineralogy of the co-disposal of fluidized bed combustion (FBC) wastes with coal slurry solid (CSS) from a coal preparation plant. During coal cleaning, pyrite and other heavy minerals and rock materials are rejected from the coal and discharged in an aqueous slurry to an impoundment. Soluble components and acid-base reaction products from mixtures of fluidized bed combustion (FBC) wastes and coal slurry solids (CSS) are being extracted in aqueous solution in a series of batch experiments. These experiments are being conducted in order to provide information on the solution chemistry associated with the mixtures over an extended time. Large volumes of extracts from three mixtures of FBC waste and CSS are being prepared for use in experiments to ascertain the adsorption/desorption reactions that occur between components of the extracts and three commonly occurring Illinois soils. A computer program that simulates the effects of pyrite oxidation and acid neutralization in a spoil heap is being corrected and improved.

22768 (DOE/PC/92548–T1) **Suppression of fine ash formation in pulverized coal flames: Quarterly technical progress report No. 2, January 1, 1993–March 31, 1993.** Kramlich, J.C.; Hoffman, D.A.; Butcher, E.K. Washington Univ., Seattle, WA (United States). Dept. of Mechanical Engineering. 29 Apr 1993. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-92PC92548. Order Number DE93015053. Source: OSTI; NTIS; GPO Dep.

The second major ash producing mechanism is the generation of a submicron aerosol through a vaporization/condensation mechanism. When the ash size distribution is plotted in terms of number density, the submicron mode generally peaks at about 0. 1 μm. When plotted in terms of mass, this mode is sometimes distinct from the residual ash mode, and sometimes merged into it. During diffusion-limited char combustion, the interior of the particle becomes hot and fuel-rich. The non-volatile oxides (e.g., Al_2O_3, SiO_2, MgO, CaO, Fe_2O_3) can be reduced to more volatile suboxides and elements, and partially vaporized. These reoxidize while passing through the boundary layer surrounding the char particle, thus becoming so highly supersaturated that rapid homogeneous nucleation occurs. This high nuclei concentration in the boundary layer promotes more extensive coagulation than would occur if the nuclei were uniformly distributed across the flow field. The vaporization can be accelerated by the overshoot of the char temperature beyond the local gas temperature. Although these particles represent a relatively small fraction of the mass, they can present a large fraction of the surface area. Thus, they are a preferred site for the condensation of the more volatile oxides later in the furnace. This leads to a layering effect in which the refractory oxides are concentrated at the particle core and the more volatile oxides resideat the surface. This also explains the enrichment of the aerosol by volatile oxides that has been noted in samples from practical furnaces. These volatile metal oxides include the majority of the toxic metal contaminants, e.g., mercury, arsenic, selenium and nickel. Risk assessment studies suggest that toxic metal emissions represent a significant portion of the health risk associated with combustion systems.

22769 (DOE/PC–93007525, pp. 12-17) **Encouraging partnerships: Cooperative research and development agreements between government and industry.** USDOE Pittsburgh Energy Technology Center, PA (United States). 1993. In *PETC Review: Issue 7, Winter 1992–1993.* 52p. Order Number DE93007525. Source: OSTI; NTIS.

Projects that result from a Cooperative Research and Development Agreement (CRADA) are described. CRADA's are the result of legislation that gives Federal laboratories a mandate to work with the private sector in researching and developing new technologies. The history of CRADA goes back to the Stevenson-Wydler Technology Innovation Act of 1980. This was an effort by Congress to encourage Federal laboratories to transfer their technology to the private sector. The legislation addressed the need to create centers for industrial technology and promoted the idea of working with private industry to share value Government processes and inventors. The benefits of CRADA's at the Pittsburgh Energy Technology Center are discussed.

22770 (KTM/E-B–127) **Combustion and gasification: Master plan for an energy technology research programme 1993-1998.** Hupa, M. (Aabo Akademi, Turku (Finland)). Ministry of Trade and Industry, Helsinki (Finland). Energy Dept. 1993. 43p. (In Finnish). Project KTM-315/881/92. Order Number DE93794853. Source: OSTI; NTIS.

LIEKKI 2 Research Programme.

Liekki 2 is largely to continue that combustion and gasification programs Liekki and Jalo. The program contains applied short-term research as well as more fundamental, long-term basic research. The applied research for immediate use is to be focused, among other things, on issues concerning pressurized fluidized techniques, especially the cleaning of the product gases resulting from pressurized combustion and gasification. Research concerning the control of emissions from large diesel engines is also central. Studies involving emissions from waste incineration will be included, too. The long-term, more basic research is not directly concerned with the development of existing plants and equipment or concepts, but adds to the general knowledge on phenomena related to combustion processes. Among other things, the program will include projects for mathematical modelling of combustion and furnaces. Some of the interesting issues are the description of suspension flow, chemical reactions under turbulent flow, and incorporating the emission chemistry into the flow calculations. Using suitable, accurately controlled laboratory equipment, partial processes such as fuel behavior at combustion, gasification, and pyrolysis under different conditions will be studied. The effect of pressure on these processes, in particular, needs further clarification. Interesting open questions concerning the chemistry of emission formation still remain. The studies under way examining the chemistry of nitrogen and sulfur compounds are worth continuing; also studying the chemistry such as that of chlorine compounds will be of interest in the future. Moreover, the behavior of ash, especially under reductive conditions, is interesting.

0150 Economic, Industrial, and Business Aspects

22771 (ETDE/JP-mf–93793769) **Australian coals expected of real cost competitive edge.: Through comparing them with U.S. coals.** Institute of Energy Economics, Tokyo (Japan). 20 Oct 1992. 31p. (In Japanese). Order Number DE93793769. Source: OSTI; NTIS; Available from The Institute of Energy Economics, Dai 10 Mori Biru, 18-1, Toranomon 1-chome, Minato-ku, Tokyo, Japan.

Discussions were given on the future supply reliability in Australian coals exported in the largest quantity in the world. The world coal demand is growing steadily, but the supply power is outgrowing the demand resulting in stagnated coal prices. Australian coals are sold domestically at 29% and exported at 71%, being strongly affected with the international market in the supply amount and price aspects. The world's coal markets transact coals in the U.S. dollar based prices, hence the exchange rates affect largely revenues from the sales. The Australian dollar has been in a trend of depreciation against the U.S. dollar during the period from 1970 through 1990, and the mining companies have been enjoying its benefit, which in reverse is a fragile structure for the Australian dollar appreciation. The coal productivity has grown from 1.8 tons/man/hour to 2.5 tons/man/hour during 1980 through 1985, approximately equivalent to that in the U.S.A. However, in 1990, the productivity was 3.1 tons in Australia while it was 3.5 tons in the U.S.A. The annual wage rise rate in Australia is 10.1%, causing a concern about increased coal mining cost. 36 figs., 11 tabs.

22772 (INIS-mf–13518, pp. E11) **Economy, ecology and market needs. Example of the coal mining industry.** Lindovsky, O. (Vyzkumny Ustav Palivoenergetickeho Komplexu, Prague (Czechoslovakia)); Najman, M. 1992. [76p.] (In Czech). (CONF-9210351–: The mining town of Pribram in science and technology, Pribram (Czechoslovakia), 12-14 Oct 1992). In *The mining town of Pribram in science and technology. Abstracts of contributions.* Order Number DE93625342. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. COAL MINING/economic analysis; BLACK COAL; COKE; MARKET

0160 Health and Safety

22773 (CONF-921275–, pp. 43-44) **Tracing by a member of the rescue party at Mitsui Miike Coal Mine.: Mainly on coal dust explosion and CO poisoning disaster at Mikawa Coal Mine.** Tsuji, N. (Ariake National College of Technology, Fukuoka (Japan)). 2 Dec 1992. 160p. (In Japanese). From 25. safety engineering study meeting; Kitakyushu (Japan); 2-3 Dec 1992. In *Proceedings of the 25th Safety Engineering Study Meeting.* Order Number DE93793904. Source: OSTI; NTIS (US Sales Only).

The paper describes activities and roles of the rescue party in the past accidents and disasters at Miike Coal Mine, particularly looking back on rescue work by Mr. S. T. who was a member of the rescue party in explosion accidents at Yamano Mine and Mikawa Mine. As for conditions and selection of the members of the rescue party, a person appropriate mentally and physically is selected and arranged for each mine and each section. Dismissal is based on the person's wish, slight unusuality of health, and age (45 years old). The member receives lectures at the Kyushu security center, obtains certification, and then works. There are such rules that the member receives training once a month, his allowance is changeable according to the degree of danger of the operation, etc. On June 1, 1965, an accident of methane gas explosion happened in which 27 persons were killed and 29 persons were poisoned by CO. Also, in November 1963, at Mikawa Mine, a coal tub cut a high-voltage cable and the spark ignited coal dust, which caused a big explosion. By roof fall and a flood, 458 and 839 persons were killed and CO poisoned, respectively. He was sent to the scene of those accidents. 3 refs., 3 figs.

22774 (CONF-921275–, pp. 57-60) **Fire and explosion hazards with powdered coal. 1.: Its heat generating and spontaneous ignition characteristics.** Itagaki, H. (Research Institute of Industrial Safety, Tokyo (Japan)); Matsuda, T.; Morisaki, S. 2 Dec 1992. 160p. (In Japanese). From 25. safety engineering study meeting; Kitakyushu (Japan); 2-3 Dec 1992. In *Proceedings of the 25th Safety Engineering Study Meeting.* Order Number DE93793904. Source: OSTI; NTIS (US Sales Only).

Coals have different degrees of heat generation and carbonization depending on types. With an objective to prevent explosive fires, this paper describes tests on different types of powdered coal (eight types with volatiles at from 5% to 44%) for their spontaneous igniting and dust explosion characteristics. The tests included thermal analyses using DTA, DSC and TG measurements, a heat insulation test using an accelerating rate calorimeter (ARC), and a spontaneous ignition test using an infrared heating device. Although specificity was observed in the relation between temperature and spontaneous heat generating rate depending on the coal types in the heat insulation test, the more the volatiles, the heat generation starting temperature decreased on the whole, and its curves did not change much even if the atmospheric condition was varied. In the infrared heating test, the critical temperature in spontaneous ignition showed a trend of decrease when deposition thickness in the test pieces increased. Reducing the deposition thickness was more effective in reducing the maximum ultimate temperature at the center of a test piece than by reducing the heating temperature. 8 figs., 2 tabs.

22775 (CONF-921275–, pp. 61-64) **Fire and explosion hazards with powdered coal. 2.: Coal dust explosion characteristics.** Matsuda, T. (Research Institute of Industrial Safety, Tokyo (Japan)); Itagaki, H.; Morisaki, S. 2 Dec 1992. 160p. (In Japanese). From 25. safety engineering study meeting; Kitakyushu

(Japan); 2-3 Dec 1992. In *Proceedings of the 25th Safety Engineering Study Meeting.* Order Number DE93793904. Source: OSTI; NTIS (US Sales Only).

Different methods for measuring coal dust explosion characteristics have been developed for ignition and explosion of coal dust associated with utilization of powdered coal. With an objective of establishing a more reasonable method for evaluating hazards thereof, this paper describes discussions on explosion hazard property values using pieces of explosion testing equipment that use from small to large containers. Three types of dust explosion testing equipment were used to measure explosion hazards in nine types of coal dust. The following results were obtained: An electric spark ignition source in a blow-up type testing equipment does not work sufficiently for dusts with relatively weak explosiveness; the maximum explosion pressure measured using a 1-m^3 testing equipment exhibited equivalent data to those with a 30-liter testing equipment, but the maximum explosion pressure rising rate was lower than that with the latter equipment; coal dust with less volatiles does not explode in this equipment; the 30-liter testing equipment tended to somewhat overestimate the explosion hazards, while the 1-m^3 testing equipment was thought to provide more practical data; and the lower explosion concentration limit and the oxygen concentration limit are relevant with the amount of volatiles. 5 refs., 7 figs.

02 PETROLEUM

0202 Reserves, Geology, and Exploration

Refer also to citation(s) 22792, 22822, 22851

22776 (DOE/BC/14425–T13-App.1-Vol.1) **Establishment of an oil and gas database for increased recovery and characterization of oil and gas carbonate reservoir heterogeneity: Appendix 1, Volume 1.** Kopaska-Merkel, D.C.; Moore, H.E. Jr.; Mann, S.D.; Hall, D.R. Alabama Geological Survey, Tuscaloosa, AL (United States). Jun 1992. 223p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-89BC14425. Order Number DE93014666. Source: OSTI; NTIS; GPO Dep.

This volume contains maps, well logging correlated to porosity and permeability, structural cross section, graph of production history, porosity vs. natural log permeability plot, detailed core log, paragenetic sequence and reservoir characterization sheet of the following fields in southwest Alabama: Appleton oil field; Barnett oil field; Barrytown oil field; Big Escambia Creek gas and condensate field; Blacksher oil field; Broken Leg Creed oil field; Bucatunna Creed oil field; Chappell Hill oil field; Chatom gas and condensate field; Choctaw Ridge oil field; Chunchula gas and condensate field; Cold Creek oil field; Copeland gas and condensate field; Crosbys Creed gas and condensate field; and East Barnett oil field. (AT)

22777 (DOE/BC/14425–T13-App.1-Vol.4) **Establishment of an oil and gas database for increased recovery and characterization of oil and gas carbonate reservoir heterogeneity: Appendix 1, Volume 4.** Kopasaka-Merkel, D.C.; Moore, H.E. Jr.; Mann, S.D; Hall, D.R. Alabama Geological Survey, Tuscaloosa, AL (United States). Jun 1992. 211p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-89BC14425. Order Number DE93014669. Source: OSTI; NTIS; GPO Dep.

This volume contains maps, well log correlated to lithology, porosity and permeability, structural cross section, graph of production history, porosity vs. natural log permeability plots; detailed core log, porosity vs. natural permeability plot for one lithofacies, paragenetic sequence and reservoir characterization sheet for the following fields in southwest Alabama: Stave Creek oil field; Sugar Ridge oil field; Toxey oil field, Turkey Creed oil field; Turnerville oil field, Uriah oil field; Vocation oil field; Wallace oil field; Wallers Creek oil field; West Appleton oil field; West Barrytown oil field; West Bend oil field; West Okatuppa Creed oil field; Wild Fork Creek oil field; Wimberly oil field; Womack Hill oil field; and Zion Chapel oil field. (AT)

22778 (DOE/ER/13711–T2) **Mechanical properties and modeling of seal-forming lithologies: Technical progress report No. 3, March 15, 1992–June 14, 1993.** Kronenberg, A.K.; Russell, J.E.; Carter, N.L.; Mazariegos, R.; Ibanez, W. Texas A and M Univ., College Station, TX (United States). Center for Tectonophysics. [1993]. 52p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG05-87ER13711. Order Number DE93015091. Source: OSTI; NTIS; GPO Dep.

Specific goals and accomplishments of this research include: (1) The evaluation of models of salt diaper ascent that involve either power law, dislocation creep as determined experimentally by Horseman et al. (1993) or linear, fluid-assisted creep as reported by Spiers et al. (1988, 1990, 1992). We have compared models assuming these two, experimentally evaluated flow laws and examined the predictions they make regarding diaper incubation periods, ascent velocities, deviatoric stresses and strain rates. (2) The evaluation of the effects of differential loading on the initiation an of salt structures. (3) Examination of the role of basement faults on the initiation and morphologic evolution of salt structures. (4) Evaluation of the mechanical properties of shale as a function of pressure and determination of the nature of its brittle-ductile transition. (5) Evaluation of the mechanical anisotropies of shales with varying concentrations, distributions and preferred orientations of clay. (6) The determination of temperature and ratedependencies of strength for a shale constitutive model that can be used in numerical models that depend on viscous formulations. (7) Determination of the mechanisms of deformation for argillaceous rocks over awide range of conditions. (8) Evaluation of the effects of H_2O within clay interlayers, as adsorbed surface layers.

22779 (ETDE/JP-mf–93794512, pp. 79-89) **Surface geochemical prospecting.: Development for marine geochemical survey system.** Takayama, K.; Shimada, T.; Ishida, K.; Fujii, J.; Matsui, H. Japan National Oil Corp., Tokyo (Japan). 30 Oct 1992. 537p. (In Japanese). In *Record of TRC's activities in the fiscal year 1991.* Order Number DE93794512. Source: OSTI; NTIS (US Sales Only).

This paper reports the results obtained during 1991 of the study on surface geochemical prospecting having been carried out by the Technology Research Center of Japan National Oil Company as one of its research operations. This study is intended to develop a technology to discover promising minable areas or detect oil beds by means of detecting trace amount of hydrocarbon gas oozing out from underground oil beds. Therefore, the study moves developments forward in systems to detect continuously trace amount gas from ocean surface and continuous trace amount gas analyzing devices, as well as discusses methods to analyze geochemical abnormalities. In developing the continuous detecting systems during 1991, a prototype towed continuous water collector was fabricated that is equipped with a device to collect continuously sea water sample for analyzing the trace amount of gas and sensors to observe sea water properties. Improvements have been given on filters for continuous degassing and analyzing devices. Further, marine experiments were conducted on the sea water area off Honjo, Akita Prefecture to verify these systems. 8 figs., 2 tabs.

22780 (ETDE/JP-mf–93794512, pp. 113-118) **Development of geophysical exploration methods for areas with complex topography and geology.: Seismic methods.** Watanabe, K.; Koike, K.; Kano, N. Japan National Oil Corp., Tokyo (Japan). 30 Oct 1992. 537p. (In Japanese). In *Record of TRC's activities in the fiscal year 1991.* Order Number DE93794512. Source: OSTI; NTIS (US Sales Only).

This paper describes studies being carried out to establish physical exploration methods effective for areas where making physical petroleum prospecting is difficult. This paper is a report on the results obtained during 1991 of the studies on seismic exploration technologies that have been continuing since 1987. The fiscal year 1991 saw preliminary and full-scale experiments on methods to bury oscillation receivers. The experiments carried out at the Teradomari and Wajima Village areas in Niigata Prefecture were unable to trace ground bed boundaries because of complex geological structures in the mountainous area causing poor continuity in the reflection faces during a seismic exploration, hence no meaningful data were obtained. To avoid this, preliminary experiments were performed to bury oscillation receivers in different depths down to 30 meters. As a result, burying them at depths greater than the thickness of the surface bed provided a possibility of obtaining high-resolution data. Full-scale experiments were then

conducted in adjacent areas on 120 oscillation receiving points at a depth of 20 meters. The results were not necessarily as good as those with surface oscillation receivers both in resolutions and S/N ratio, but a number of finding were derived in association with the data. 6 figs.

22781 (ETDE/JP-mf–93794512, pp. 119-124) **Development of geophysical exploration methods for areas with complex topography and geology.: Electromagnetic methods.** Takeda, H.; Shiga, N.; Kano, N. Japan National Oil Corp., Tokyo (Japan). 30 Oct 1992. 537p. (In Japanese). In *Record of TRC's activities in the fiscal year 1991.* Order Number DE93794512. Source: OSTI; NTIS (US Sales Only).

This paper describes studies being carried out to establish physical exploration methods effective for areas where making physical petroleum prospecting is difficult. This paper is a report on the results obtained during 1991 of the studies on electromagnetic exploration technologies that have been continuing since 1987. In the fiscal year 1991, a time-domain electromagnetic method (TDEM), one of the electromagnetic exploration technologies, was experimented on to verify its effectiveness on about 100 measuring points spaced in 500-m intervals at the Yasuda-Matsunoyama area in Niigata Prefecture where the seismic exploration data have been very poorly recorded. The signalling power supply electrode pairs were flown with square wave current at 161 A p-p. The conclusion obtained may be summarized as follows: Although noises were somewhat high in this survey area, possibly requiring part of the data to be re-processed and re-analyzed, the specific resistance distribution for down to about 5 km below the surface was derived; the specific resistance structure consists broadly of a three-layer structure comprising the surface, lower and higher beds with different specific resistances; and shapes of the boundary faces were recognized with a moderately inclining structure in the vicinity of the center of the boundaries. 7 figs.

22782 (ETDE/JP-mf–93794512, pp. 125-129) **Development of geophysical exploration methods for areas with complex topography and geology.: Integrated interpretation technique.** Shiga, N.; Watanabe, K.; Takeda, H.; Koike, K.; Kano, N. Japan National Oil Corp., Tokyo (Japan). 30 Oct 1992. 537p. (In Japanese). In *Record of TRC's activities in the fiscal year 1991.* Order Number DE93794512. Source: OSTI; NTIS (US Sales Only).

Developments have begun since 1990 on methods to infer underground structures with high reliability by means of utilizing fully the underground information obtained from different physical exploration means. This is part of the efforts of developing geophysical exploration methods for ares with complex topography and geology in the large-size research project carried out by the Technology Development Center of Japan National Oil Corporation. In the fiscal year 1991, the case study performed in the previous year at the northern slope of Mt. Chokai was expanded to the extent where the seismic exploration results were compared with the results of integrated interpretation on the electromagnetic prospecting method and the specific resistance method. The comparison was made basically through the repetition of a cycle comprising a comparative discussion on images of underground structures obtained from different physical exploration methods, re-processing of individual physical exploration results followed by re-analysis, and a comparative discussion on modified images of underground structures. Inferences were given on underground structures that satisfy the comparison result as much as possible. It was possible, for example, to identify approximate specific resistance distribution down to a great underground depth with use of the electromagnetic exploration methods (consisting of three processes), and detailed specific resistance distribution at shallow depths with use of the specific resistance exploration method. These data were integrated to derive a two-dimensional specific resistance model. 1 ref., 6 figs.

22783 (ETDE/JP-mf–93794512, pp. 151-159) **Application of geophysical methods to reservoir characterization.: High resolution 3D seismic survey.** Sengoku, Y. Japan National Oil Corp., Tokyo (Japan). 30 Oct 1992. 537p. (In Japanese). In *Record of TRC's activities in the fiscal year 1991.* Order Number DE93794512. Source: OSTI; NTIS (US Sales Only).

This paper is a 1991 annual report on a research having been carried out since 1986 as a sub-theme in the large-scale research project 'geophysical methods for exploring oil reservoir structures'. The research is to develop technologies to identify patterns and distribution of oil-gas reservoirs and infer reservoir rock characteristics including porosities using a high-resolution three-dimensional seismic exploration method. In 1991, investigations were carried out on the relation between reservoir rock characteristics and acoustic impedance using the Amarume oil field in Yamagata Prefecture as an experimental field. Based on the analysis of bed inspection data using research wells, the relation between characteristics of different reservoir rocks and acoustic impedance or velocity was discussed. Among the B1 sand bed, the upper B2 sand bed and the lower B2 sand bed, a best correlation was recorded at the B2 sand bed between the acoustic impedance and the effective porosity. When a multi variables linear regression method was used that is added with contents of clay and shale as correction terms, the correlation coefficient was 0.9 to 0.95. On the other hand, a finding was obtained that the correlation coefficient varies greatly depending on whether the pores are filled with gas or oil. 13 figs., 1 tab.

22784 (ETDE/JP-mf–93794512, pp. 449-455) **Basic research for environmental data in the arctic regions.** Shoda, N.; Tezuka, N. Japan National Oil Corp., Tokyo (Japan). 30 Oct 1992. 537p. (In Japanese). In *Record of TRC's activities in the fiscal year 1991.* Order Number DE93794512. Source: OSTI; NTIS (US Sales Only).

With objectives of collecting and accumulating environmental data in the arctic region and establishing their data base, a research has been carried out over a period from 1990 to 1993 fiscal years as one of the continuing researches at the Petroleum Development Technology Center. This paper is a report on the results obtained during the fiscal 1991. Subsequent to the basic surveys and data base concept designs performed in the previous year, the year 1991 saw the Center's participation in two scientific societies and one joint survey to collect related information. Out of the subjected 24 sea areas, 19 areas were surveyed to collect environmental data. The data consist of about 20 items including meteorological, hydrographical, cryogenic, and oceanogeological data. The data comprise mainly statistical data, with their reliability investigated at the same time. The data base was discussed as to its subject users, hardwares and softwares as its operating environment. As a result, it was decided that the data base should be structured with relatively general purpose hardwares and softwares under an assumption that its major users are engineers at petroleum development companies. 5 figs., 3 tabs.

22785 (NEI-DK–1131) **Further development of a mathematical model to simulate the natural fracturing of rocks in oil and gas bearing chalk reservoirs: 3D finite element analysis. Status report.** Petersen, K. Geoteknisk Inst., Lyngby (Denmark). Apr 1992. 35p. Contract ENS-1313/89-9. Order Number DE93794680. Source: OSTI; NTIS.

Modelling of a field in the Danish part of the North Sea. EFP-89.

An advanced three-dimensional finite element program, ABAQUS, has been implemented and used in a number of different connections at the Danish Gjeotechnical Institute. DGI also disposes over the requisite hardware capacity for calculations of rather detailed, spatial finite element models. This report illustrates by examples a selection of the possibilities of finite element simulation of the geological development as well as the development of the stress and strain conditions of an oil reservoir in the Danish part of the North Sea. One calculation was performed under completely drained conditions, i.e. pore pressure not taken into account. The calculation was carried through to the planned final state, simulating the development of the field for the last some 1.7 million years. Another calculation was performed based on consolidation theory, i.e. pore pressure taken into account. An initial state was produced by means of a partly executed calculation corresponding to the conditions some 1.7 million years ago. This initial state could be used for the continued final calculation. The main result of the calculations is a realistic stress/strain field in the simulated reservoir, being a useful starting point for simulating the future production potential to the field. (AB).

22786 (NEI-DK–1132) **Numerical method to describe the deformation of chalk reservoirs.** Olsen, A. (Geological Survey of

Denmark (Denmark)); Rasmussen, F.O. Danmarks Geologiske Undersoegelske, Copenhagen (Denmark). [1992]. 9p. Contract ENS-1313/89-9. Order Number DE93794681. Source: OSTI; NTIS.

Modelling of a field in the Danish part of the North Sea. EFP-89.

A two-step method is described which enables the depositional history and the structural development to be simulated. The method is illustrated by simulation of a North Sea field containing a chalk reservoir with a large overpressure. The simulation is based on back-stripping techniques including decompaction calculations in which sediments are "unloaded" in successively older time steps. The first step involves 1D consolidation calculations in a number of wells in the area, implying coupling of compaction and flow of pore fluid. The compaction is solved by soil mechanics constitutive laws including time dependent deformations. These laws provide effective stresses, pore pressures, thicknesses and void ratios as functions of time. This makes it possible to model the behavior of overpressured shales. The computations are iterative forward modelling, and the results are compared to the present day situation. A decompaction factor is introduced. This factor describes the relative change of computed thickness for a given layer during a time interval. It is possible to include flow between the wells in a particular layer, such as a chalk reservoir, and thereby make the model partly three-dimensional. The decompaction factors for the wells can be interpolated, and thereby provide a field-wide description of the decompaction during each time interval. In the second step - the back-stripping - the decompaction factors are used instead of the traditional depth/porosity relations. In this way geotechnical methods are introduced into the back-stripping technique. At the Danish Geotechnical Institute (DGI) the results of this modelling has been used in calculations of two or three dimensional stress fields, fracture directions and intensity at different times. These computations are described in the companion paper by K. Petersen et al. "Natural stress field in a chalk reservoir predicted by spatial finite element analysis". (au).

22787 (NEI-DK–1133) **Natural stress field in a chalk reservoir predicted by spatial finite element analysis.** Petersen, K. (Danish Geotechnical Institute, (Denmark)); Foged, N.; Olsen, A.; Rasmussen, F.O. Danmarks Geologiske Undersoegelske, Copenhagen (Denmark). [1992]. [12p.] Contract ENS-1313/89-9. Order Number DE93794682. Source: OSTI; NTIS.

Modelling of a field in the Danish part of the North Sea. EFP-89.

This paper exemplifies the potential of spatial finite element analysis to simulate the geological and stress/strain related development in an oil reservoir in Danish part of the North Sea. The basic depositional history and the structural development of the actual field was simulated numerically at the Geological Survey of Denmark (DGU). This simulation is described in the companion entitled paper by A. Olsen et al. "Numerical method to describe the deformation of chalk reservoirs". Based on the basic input from DGU two principly different elastic-plastic calculations are carried out. In the first calculation the excess pore pressure developing throughout the simulation of the depositional history is disregarded, i.e. the material behaviour is considered totally drained throughout the calculation. Conversely pore pressure development is fully accounted for in the other type of calculation, i.e. the material behaviour encompass consolidation theories in order to solve the coupled diffusion/equilibrium equations simultaneously. The latter calculation was unfortunately not carried through to the planned finale state, due to project specific hardware limitations. A main result of the calculations is a more realistic stress field compared to the up to now often applied stress field based on a straight forward at-rest condition (K_0-condition). Subsections of such an improved stress field could be used as an initial state for a simulated well production history in the actual field leading to a higher degree of efficiency in the evaluation of bore hole stability and fracturing in deviated wells. (au).

22788 (NEI-DK–1137) **Further development of a mathematical model to simulate fracturing in chalk reservoirs: Modelling in a field in the Danish part of the North Sea.** DGU Service report, 3. Olsen, A.; Mathiesen, A. Danmarks Geologiske Undersoegelske, Copenhagen (Denmark). 1993. 44p. Contract ENS-1313/89-9. Order Number DE93794679. Source: OSTI; NTIS.

EFP-89.

A method enabling structural stress/strain to be simulated is illustrated in relation to a North Sea field containing a chalk reservoir with a significant amount of over-pressure. After defining geological and geometrical data, backstripping techniques include decompaction calculations involving one dimensional consolidation reckonings implying coupling of compaction and flow of pore fluid. This makes it possible to model the behaviour of over-pressured shales. A decompaction factor describes the relative change of computed thickness for a given layer during a time interval. Interpolation of these factors gives a field-wide description of decompaction during each time interval. In back-stripping the decompaction factors are used instead of traditional depth/porosity relations, enabling the excess pore pressure to be considered. Stress and strain related development is predicted in a three dimensional spatial finite time analysis. An elastic-plastic calculation including drained material behaviour showed very promising results. Another type of this calculation takes pore pressure development into account and encompasses consolidation theories. (AB).

22789 (NEI-DK–1164) **Concepts for offshore exploration on pack-ice areas - phase 2: Summary report.** Cowiconsult Raadgivende Ingenioerer A/S, Lyngby (Denmark); Dansk Hydraulisk Inst., Hoersholm (Denmark); Oedegaard og Danneskiold-Samsoee ApS, Copenhagen (Denmark); Britsurvey, Great Yarmouth (United Kingdom); Thyssen Nordseewerke GmbH, Emden (Germany). Feb 1993. [45p.] Contract ENS-1313/90-0014;Contract ENS-1313/91-0013;Contract CEC Order Number DE93794729. Source: OSTI; NTIS.

EFP-90; EFP-91.

The area offshore North-East-Greenland (NEGS) was selected as target area for the study because NEGS area includes the most attractive frontier basins for petroleum exploration in Greenland and the fact that the severe ice conditions reduces the accessability of the area to about 1 month a year in most of the area. The project is carried out using an icebreaking seismic vessel towing conventional seismic equipment. The actual seismic lines of the regional survey may deviate from the planned lines depending of local ice conditions. Alternative seismic concepts were investigated following the requirements that operations should be possible all year round, a detailed coverage of local areas should be possible and that data quality should match industry standard of conventional seismic operations. The main result is a new seismic concept including a seismic icebreaker with an onboard submarine designed by Thyssen Nordseewerke. The icebreaker may be used for gathering 3-D seismic when the ice conditions allow towing of the seismic array. The submarine can be launched for continuation in difficult ice conditions. Problems regarding towing the streamer from a submarine was studied. Ice conditions were investigated the concept for Sea Ice Information management was prepared. The quality of the seismic data was studied. A major part of the project address the many problems connected with the submarine operations. The Danish Navy has assisted with information of submarine operations and safety conditions. Problems connected with towing the seismic equipment were examined. (AB) (11 refs.).

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Refer also to citation(s) 22776, 22777, 22846, 22853, 23937, 24269

22790 (DOE/BC/14246–11) **Microbial field pilot study: Final report.** Knapp, R.M.; McInerney, M.J.; Menzie, D.E.; Coates, J.D.; Chisholm, J.L. Oklahoma Univ., Norman, OK (United States). May 1993. 212p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-89BC14246. Order Number DE93000140. Source: OSTI; NTIS; GPO Dep.

A multi-well microbially enhanced oil recovery field pilot has been performed in the Southeast Vassar Vertz Sand Unit in Payne County, Oklahoma. The primary emphasis of the experiment was preferential plugging of high permeability zones for the purpose of improving waterflood sweep efficiency. Studies were performed to determine reservoir chemistry, ecology, and indigenous bacteria populations. Growth experiments were used to select a nutrient system compatible with the reservoir that encouraged growth of a group of indigenous nitrate-using bacteria and inhibit growth of

sulfate-reducing bacteria. A specific field pilot area behind an active line drive waterflood was selected. Surface facilities were designed and installed. Injection protocols of bulk nutrient materials were prepared to facilitate uniform distribution of nutrients within the pilot area. By the end of December, 1991, 82.5 tons (75.0 tonnes) of nutrients had been injected in the field. A tracer test identified significant heterogeneity in the SEVVSU and made it necessary to monitor additional production wells in the field. The tracer tests and changes in production behavior indicate the additional production wells monitored during the field trial were also affected. Eighty two and one half barrels (13.1 m^3) of tertiary oil have been recovered. Microbial activity has increased CO_2 content as indicated by increased alkalinity. A temporary rise in sulfide concentration was experienced. These indicate an active microbial community was generated in the field by the nutrient injection. Pilot area interwell pressure interference test results showed that significant permeability reduction occurred. The interwell permeabilities in the pilot area between the injector and the three pilot production wells were made more uniform which indicates a successful preferential plugging enhanced oil recovery project.

22791 (DOE/BC/14472–11) **Characterization of the gravity drainage phenomena through numerical and physical simulation.** Johnson, L.A. Jr.; Satchwell, R.M.; Mones, C.G.; Carlson, F.M. University of Wyoming Research Corp., Laramie, WY (United States). Western Research Inst. Oct 1992. 180p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-90BC14472. (WRI–92-R051). Order Number DE93014191. Source: OSTI; NTIS; GPO Dep.

The gravity drainage mechanism is a contributor to primary, secondary, and tertiary oil production processes. In some cases, this mechanism is an insignificant contributor when compared to the other drive mechanisms. However, in depleted or shallow reservoirs, the gravity drainage mechanism may be the only producing mechanism. Several models have been developed to simulate the oil production processes. However, these previous modeling efforts have ignored the contribution from the gravity drainage mechanism. Therefore, these simulators are inaccurate in predicting the production rates when gravity drainage is the primary production mechanism. To predict the performance of the gravity drainage mechanism, a two part program of (1) developing an effective numerical simulator for the gravity drainage phenomenon and (2) conducting physical simulations to provide validation data for the model was undertaken. The first part of this report describes the physical simulations conducted to validate the numerical model. In the second part, the development and validation of the numerical simulator is presented. The developed.numerical simulator proved effective in evaluating fluid movement by gravity drainage. The model successfully simulated the cocurrent and countercurrent (phase segregation) movement of fluids and accurately portrayed capillary pressure effects. The implicit formulation of the model provided stable operation for all simulations performed in this study. Simulations can be made in one or three spatial dimensions. Full documentation of the simulator, a copy of the simulator code, a users guide, and an example case are provided.

22792 (DOE/BC/14657–12) **Measuring and predicting reservoir heterogeneity in complex deposystems: Quarterly technical report, January–March 1993.** Donaldson, A.C.; Shumaker, R.; Laughrey, C.; Aminian, K.; Hohn, M.E. Appalachian Oil and Natural Gas Research Consortium, Morgantown, WV (United States). 15 Apr 1993. 23p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-90BC14657. Order Number DE93014539. Source: OSTI; NTIS; GPO Dep.

This research is designed to use a multi-disciplinary approach to measure and map heterogeneity at various scales, and ultimately to develop tools and techniques to predict heterogeneity, both in existing fields and in undrilled areas. Two stratigraphic units have been chosen for this research: the Big Injun sandstone (Mississippian) in West Virginia, and the Rose Run Sandstone (Ordovician) in Ohio and Pennsylvania. Six milestones were scheduled for completions during the reporting period: comparing heterogeneity observed in cores with the anticipated deposystem interpretation; integration of structural and other interpretations; completing a final report on regional structure and the influence of structure on field formation; creation of the best seismic-derived geologic model; completing the thin section analysis of the Big Injun; and completing a study on well spacing. Four of these were completed on or ahead of schedule.

22793 (DOE/BC/14852–2) **Scale-up of miscible flood processes.** Orr, F.M. Jr. Stanford Univ., CA (United States). Dept. of Petroleum Engineering. [1993]. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-92BC14852. Order Number DE93014533. Source: OSTI; NTIS; GPO Dep.

The current project is a systematic research effort aimed at quantifying the interactions of physical mechanisms that control the scaling behavior of miscible floods. Displacement performance in a miscible flood is the result of a complex set of competing and interacting mechanisms. Phase behavior is of fundamental importance because the transfer of components from the oil to the injected fluid (as in most CO_2 floods) or from the injected fluid to the oil (as in rich gas floods) can generate mixture compositions with displacement properties very different from those of pure CO_2 and original oil. The goal of this project, is to make more accurate quantitative predictions of the impact of nonuniform flow, crossflow and phase behavior in flows in heterogeneous reservoir rocks. In past reports, we have discussed the instabilities arising from unfavorable mobility ratios that occur during injection of a solvent such as CO_2. In this report, two-dimensional (2D) and three-dimensional (3D) computations by a particle-tracking technique are compared for unstable displacements in homogeneous porous media, with and without gravity. In homogeneous porous media without gravity, 2D fingering patterns and the length of the transition zone are nearly the same as those obtained in 3D displacements. When gravity is added, however, calculated gravity tongues and fingering patterns can be very different when viscous and gravity forces are of comparable magnitude. We summarize results obtained by Ph.D. student Hamdi Tchelepi concerning 2D and 3D fingering in homogeneous media, and we compare displacements with and without gravity segregation. The computations show conclusively that there are some situations in which 2D simulations reproduce 3D behavior well and others for which they do not.

22794 (DOE/BC/14860–1) **Detailed evaluation of the West Kiehl alkaline-surfactant-polymer field project and it's application to mature Minnelusa waterfloods: Technical progress report, January–March 1993.** Pitts, M.J. Surtek, Inc., Golden, CO (United States). 1993. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-93BC14860. Order Number DE93014610. Source: OSTI; NTIS; GPO Dep.

The objective of this report is to (1) quantify the incremental oil produced from the West Kiehl alkaline-surfactant-polymer project by classical engineering and numerical simulation techniques,(2) to quantify the effect of chemical slug volume injection on incremental oil in the two swept areas of the field, (3) to determine the economic ramifications of the application of the alkaline-surfactant-polymer technology, (4) to forecast the results of injecting an alkaline-surfactant-polymer solution to mature waterfloods and polymer floods, and (5) to provide the basis for independent operators to book additional oil, reserves by using the alkaline-surfactant-polymer technology. This report document the initial geological and reservoir engineering data gathering. In addition, some of the initial laboratory results are discussed. Some evaluation of the West Kiehl has been published.

22795 (DOE/BC/14864–1) **Study of hydrocarbon miscible solvent slug injection process for improved recovery of heavy oil from Schrader Bluff Pool, Milne Point Unit, Alaska: [Quarterly] report, January 1, 1993–March 31, 1993.** Sharma, G.D. Alaska Univ., Fairbanks, AK (United States). Petroleum Development Lab. 1993. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-93BC14864. Order Number DE93014608. Source: OSTI; NTIS; GPO Dep.

The ultimate objective of this three-year research project is to evaluate the performance of the hydrocarbon miscible solvent slug process and to assess the feasibility of this process for improving recovery of heavy oil from Schrader Bluff reservoir. This will be accomplished through measurement of PVT and fluid properties of Schrader Bluff oil, determination of phase behavior of Schrader Bluff oil solvent mixtures, asphaltene precipitation tests, slim tube

displacement tests, core flood experiments and reservoir simulation studies. The expected results from this project include: determination of optimum hydrocarbon solvent composition suitable for hydrocarbon miscible solvent slug displacement process, optimum slug sizes of solvent needed, solvent recovery factor, solvent requirements, extent and timing of solvent recycle, displacement and sweep efficiency to be achieved and oil recovery. Work performed during quarter includes preliminary reservoir fluid characterization and multiple contact test runs using equation-of-state (EOS) simulator. Reservoir fluid samples are being acquired from Conoco Inc., and the process is expected to continue through the next quarter. Also, the experimental apparatus for the displacement study was set up.

22796 (DOE/BC/14881–2) **Improving reservoir conformance using gelled polymer systems: Second quarterly report, December 25, 1992–March 24, 1993.** Green, D.W.; Willhite, G.P. Kansas Univ., Lawrence, KS (United States). 9 Apr 1993. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-92BC14881. Order Number DE93014532. Source: OSTI; NTIS; GPO Dep.

The general objectives are to (1) to identify and develop gelled polymer systems which have potential to improve reservoir conformance of fluid displacement processes, (2) to determine the performance of these systems in bulk and in porous media, and (3) to develop methods to predict the capability of these systems to recover oil from petroleum reservoirs. This work focuses on three types of gel systems - an aqueous polysaccharide (KUSPI) system that gels as a function of pH, the chromium-based system where polyacrylamide and xanthan are crosslinked by CR(III) and an organic crosslinked system. Development of the KUSPI system and evaluation and identification of a suitable organic crosslinked system will be done. The laboratory research is directed at the fundamental understanding of the physics and chemistry of the gelation process in bulk form and in porous media. This knowledge will be used to develop conceptual and mathematical models of the gelation process. Mathematical models will then be extended to predict the performance of gelled polymer treatments in oil reservoirs. Accomplishments for this period are presented for the following tasks: development and selection of gelled polymer systems, physical and chemical characterization of gel systems; and mathematical modeling of gel systems.

22797 (DOE/BC/14882–2) **Responsive copolymers for enhanced petroleum recovery: Quarterly technical progress report, December 22, 1992–March 21, 1993.** Hester, R.; McCormick, C. University of Southern Mississippi, Hattiesburg, MS (United States). Dept. of Polymer Science. 1993. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-92BC14882. Order Number DE93014531. Source: OSTI; NTIS; GPO Dep.

The overall objective of this research is the development of advanced water-soluble copolymers for use in enhanced oil recovery which rely on reversible microheterogeneous associations for mobility control and reservoir conformance. Technical progress is summarized for the following tasks: advanced copolymer synthesis; characterization of molecular structure; and solution rheology.

22798 (DOE/BC/14884–1) **Surfactant loss control in chemical flooding: Spectroscopic and calorimetric study of adsorption and precipitation on reservoir minerals: Quarterly technical progress report, September 30, 1992–December 31, 1992.** Somasundaran, P. Columbia Univ., New York, NY (United States). Lowell Memorial Library. 1 Feb 1993. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-92BC14884. Order Number DE93014741. Source: OSTI; NTIS; GPO Dep.

The aim of this project is to elucidate the mechanisms of adsorption and surface precipitation of flooding surfactants on reservoir minerals. Effect of surfactant structure, surfactant combinations and other inorganic and polymeric species will also be determined using solids of relevant mineralogy. A multi-pronged approach consisting of micro & nano spectroscopy, microcalorimetry, electrokinetics, surface tension and wettability will be used to achieve the goals. The results of this study should help in controlling surfactant loss in chemical flooding and also in developing optimum structures and conditions for efficient chemical flooding processes. Adsorption of selected individual surfactants on oxide minerals was determined. The aim was to characterize the microstructure of the adsorbed layers. Work was began with alkyl phenoxy polyoxyether type nonionic surfactants and anionic meta xylene sulfonates.

22799 (DOE/BC/14886–2) **Investigation of oil recovery improvement by coupling and interfacial tension agent and a mobility control agent in light oil reservoirs: Technical progress report, January–March 1993.** Pitts, M.J. Surtek, Inc., Golden, CO (United States). 1993. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-92BC14886. Order Number DE93014538. Source: OSTI; NTIS; GPO Dep.

The study will investigate two major areas concerning coinjecting an interfacial tension reduction agent(s) and a mobility control agent. The first will consist of defining the mechanisms of interaction of an alkaline agent, a surfactant, and a polymer on a fluid-fluid and a fluid-rock basis. The second is the improvement of the economics of the combined technology. This report examines the effect of different alkaline agents, surfactants, and combinations of surfactant and alkaline agents on the reduction of interfacial tension between a fluvial. deltaic crude oil and the aqueous solution. In addition, the effect of alkali and surfactant addition to polymer solution viscosity are evaluated. Finally, the effect of increasing temperature on the interfacial tension characteristics and solution viscosity characteristics are discussed.

22800 (DOE/BC/14951–1) **Integrated approach towards the application of horizontal wells to improve waterflooding performance: [Quarterly] report, January 1–March 31, 1993.** Kelkar, B.G. Tulsa Univ., OK (United States). 1993. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC22-93BC14951. Order Number DE93014607. Source: OSTI; NTIS; GPO Dep.

The overall purpose of the proposed project is to improve secondary recovery performance of a marginal oil field through the use of a horizontal injection well. The location and direction of the well will be selected based on the detailed reservoir description using integrated approach. We expect that 2 to 5 % of original oil in place will be recovered using this method. This should extend the life of the reservoir by at least 10 years. To accomplish the goals of the project, it is divided into two stages. In Stage 1, we will select part of the Glenn Pool field, and collect additional reservoir data by conducting cross bore hole tomography surveys and formation microscanner logs through newly drilled well. In addition, we will also utilize analogous outcrop data. By combining the state of the art data with conventional core and log data, we will develop a detailed reservoir description based on integrated approach. After conducting extensive reservoir simulation studies, we will select a location and direction of a horizontal injection well. The well will be drilled based on optimized design, and the field performance will be monitored for at least six months. If the performance is encouraging, we will enter into second budget period of the project. If continued, the second budget period of the project will involve selection of part of the same reservoir, development of reservoir description using only conventional data, simulation of flow performance using developed reservoir description, selection of a location and direction of a horizontal injection well, and implementation of the well followed by monitoring of reservoir performance. During this quarter, the technical progress is limited due to contractual problems associated with signing of the contracts with the subcontractors. Once all the contracts are signed, the project will pick up the speed and progress according to the plans.

22801 (DOE/BC/14952–2) **Secondary oil recovery from selected Carter sandstone oilfields, Black Warrior Basin, Alabama.** Anderson, J.C. Anderman/Smith Operating Co., Denver, CO (United States). 15 Apr 1993. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC22-93BC14952. Order Number DE93014609. Source: OSTI; NTIS; GPO Dep.

The objectives of this secondary oil recovery project involving the Carter sandstone in northwest Alabama are: (1) To increase the ultimate economic recovery of oil from the Carter reservoirs, thereby increasing domestic reserves and lessening US dependence on foreign oil; (2) To extensively model, test, and monitor the reservoirs so their management is optimized; and (3) To assimilate and

transfer the information and results gathered to other US oil companies to encourage them to attempt similar projects. Start-up water injection began on 0 1/12/93 at the Central Bluff Field, and daily operations began on 01/13/93. These operations include monitoring wellhead pressures at the injector and two producers, and injection water treatment. Water injection was running 200-300 bbl/day at the end of February. Once the unit is pressured-up well testing will be performed. Unitization was approved on 03/01/93.b. For the North Fairview Field correlations and log analyses were used to determine the fluid and rock properties. A summary of these properties is included in Table 1. The results of the log analysis were used to construct the hydrocarbon pore volume map shown on Figure 1. The map was planimetered to determine original oil-in-place (OOIP) values and the hydrocarbon pore volume by tract. The OOIP summed over an tracts by this method is 824.7 Mbbl (Figure 2). Original oil-in-place was also calculated directly: two such independent calculations gave 829.4 Mbbl (Table 1) and 835.6 Mbbl (Table 2). Thus, the three estimates of OOIP are within one percent. The approximately 88% of OOIP remaining provides an attractive target for secondary recovery. Injection start-up is planned for mid-June.

22802 (DOE/BC/14958–2) **Green River Formation Water Flood Demonstration Project, Uinta Basin, Utah: Quarterly technical progress report, January 1–March 31, 1993.** Lomax, J.D. (Lomax Exploration Co., Salt Lake City, UT (United States)); Nielson, D.L.; Deo, M.D. Lomax Exploration Co., Salt Lake City, UT (United States). 1993. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC22-93BC14958. Order Number DE93014543. Source: OSTI; NTIS; GPO Dep.

The project concerns itself with increasing recoverable petroleum resources in the United States. The Green River Formation in Utah's Uinta Basin contains abundant hydrocarbons that are not easily recovered by means. The successful Lomax Monument Butte Unit water flood will be evaluated under this contract, and based on this information, water floods will be initiated in nearby Travis and Boundary units. In 1987, Lomax Exploration Company started a successful water flood on their Monument Butte Umt. This is a low-energy, geologically heterogeneous reservoir producing a waxy crude oil. production yielded about 5% of the OOIP, while the water flood will yield an recovery of 20% OOIP. The drilling and completion of two of the wells, one in the Monument Butte unit (10–34) and the other in the Travis (14A–28) unit, were related in the last report (December 31, 1992). The use of novel logging techniques (Formation Microimaging and Magnetic Resonance Imaging) along with the compositions of the oils and gases from the Monument Butte unit were also discussed. To update the progress of the above two wells, the Monument Butte 10–34 (11/27/92 first production) has produced 4,953 barrels of oil and 4,039 Mcf of gas and the Travis 14A-28 (1/1/93 first production) has produced 6,187 barrels of oil and 7,829 Mcf of gas from inception through March 31, 1993. Due to the success of the Travis 14A–28 completion, we recompleted the behind pipe "D" zone in the Travis 14–28 on March 8, 1993. The 14–28 has produced 2,411 barrels of oil through March 31, 1993 or 105 barrels per day.

22803 (DOE/BC/14959–2) **Revitalizing a mature oil play: Strategies for finding and producing unrecovered oil in Frio Fluvial-Deltaic reservoirs of South Texas: Technical progress report, January 1, 1993–March 31, 1993.** Tyler, N. Texas Univ., Austin, TX (United States). Bureau of Economic Geology. 31 Mar 1993. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC22-93BC14959. Order Number DE93014530. Source: OSTI; NTIS; GPO Dep.

During this second project quarter, screening of South Texas fields within the Frio Fluvial-Deltaic Sandstone/Vicksburg Fault Zone oil play was completed. Fields were to identify reservoirs that have a large remaining oil resource, are in danger of premature abandonment, and have geological and production data in sufficient quantity and of suitable quality to facilitate advanced reservoir characterization studies (subtask 1). Two fields have been selected for inclusion in this study: Tijerina-Canales-Blucher (T.C.B.) Field, located in the northern portion of the trend in Jim Wells County, and Rincon Field, located to the south in Starr County. Current plans are to incorporate data from both fields in our reservoir characterization and targeted resource addition studies. Project members met with operators of both fields to review available geologic and production field data and discuss our research plans. The collection of detailed geologic and production data required for the initial reservoir characterization studies (subtask 2) is currently underway. Details outlining specifics of project accomplishments for this quarter are provided.

22804 (DOE/CE/15553–T3) **System to inject steam and product oil from the same wellbore through downhole valve switching: Third quarterly report.** Gondouin, M. S-Cal Research Corp., San Rafael, CA (United States). 11 Jun 1993. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG01-92CE15553. Order Number DE93015355. Source: OSTI; NTIS; GPO Dep.

The detailed design of a sliding sleeve valve operated by wireline has been completed. This Downhole Valve is obtained by modifications of two 2 7/8 in. commercial wireline-retrievable sleeve assemblies,which will be used to connect one of the upper branches of the patented Dual Whipstock to the 2 3/8 in. steam tubing,through a thermal expansion joint. Detailed engineering drawings and materials specifications have been completed. The design of the 30 ft-long joint comprising an H joint at the top a dual whipstock at the bottom and flow control devices for up to three drainholes equipped with 1.75 in. liners has been completed for a 7 in. cased well. This combination may be used in multi-layered reservoirs as well as in single layered reservoirs. It is also compatible with rod pump locations either above the kick-off pointsor near the base of the curved part of the drainhole liners. This design provides sufficient flexibility for most potential applications in the California market.

22805 (DOE/MC/26031–11) **Field verification of CO_2-foam: [Quarterly] report, January 1–March 31, 1993.** Martin, F.D.; Heller, J.P.; Weiss, W.W. New Mexico Inst. of Mining and Technology, Socorro, NM (United States). New Mexico Petroleum Recovery Research Center. 1993. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG21-89MC26031. (PRRC–93-12). Order Number DE93014517. Source: OSTI; NTIS; GPO Dep.

This project is a cooperactive industry-university-government effort to transfer laboratory research technology to a field demonstration test. The primary objective of the project is to evaluate the use of foam for mobility control and fluid diversion in a field-scale CO_2 flood. Seven tasks were identified for the completion of this four-year project: (1) evaluate and select a field site, (2) develop an initial site-specific plan, (3) conduct laboratory CO_2-foam mobility tests, (4) perform reservoir simulations, (5) design the foam slug, (6) implement a field test, and (7) evaluate results. The East Vacuum Grayburg/San Andres Unit (EVGSAU), operated by Phillips Petroleum Company (PPCo), is the site selected for a comprehensive evaluation of the use of foam for improving the effectiveness of a CO_2 flood. The project began in late 1989, and is now in the fourth and final year. The foam test design called for the initial injection of surfactant solution to satisfy the adsorption requirement of the reservoir followed by a rapid surfactant-alternating-gas (SAG) mode. The rapid SAG mode consists of 3-day cycles of surfactant solution (3000 RB) alternated with 12-day cycles of CO_2 (12,000 RB). Thus, the rapid SAG should closely approach the benefits achieved by simultaneous injection of surfactant solution and CO_2, and would provide an approximate foam quality of 80%. This quarterly report provides an update on the recent results obtained from the foam injection test and a status of supporting research related to the project.

22806 (ETDE/JP-mf–93794512, pp. 243-247) **Well Stimulation technology.: Computer modeling and laboratory experiment of hydraulically induced fractures.** Onoe, S.; Sugiyama, H.; Nanba, T. Japan National Oil Corp., Tokyo (Japan). 30 Oct 1992. 537p. (In Japanese). In *Record of TRC's activities in the fiscal year 1991.* Order Number DE93794512. Source: OSTI; NTIS (US Sales Only).

A discussion is given on a simulation model intended to optimize hydraulic fracturing methods, as a research related to the 'well stimulation technology' research program. This paper reports the results obtained during the fiscal year 1991. A development work

was launched on a three-dimensional hydraulic fracturing simulator for a fracture (shape prediction) model based on the investigative studies that had been carried out by the end of the previous fiscal year. The work aims at developing a crack stress analyzing program using a three-dimensional boundary element method, an inter-crack flow analyzing program using a two-dimensional finite element method, and a practical simulator to solve both programs. A basic design was performed on the former two items to begin with. A discussion was given on a method to evaluate a post-fracture model using finite conductivity solution in place of the infinite conductivity solution used in fiscal 1990. Further, efforts were made on improving the experimental accuracy in experimenting the hydraulic fracturing model, which made an experiment with sufficient reproducibility possible by means of integrating the mortar curing conditions. 1 fig., 1 tab.

22807 (ETDE/JP-mf–93794512, pp. 254-258) **Microbial EOR technology.** Murata, S.; Kogachi, T.; Shiroichi, Y. Japan National Oil Corp., Tokyo (Japan). 30 Oct 1992. 537p. (In Japanese). In *Record of TRC's activities in the fiscal year 1991.* Order Number DE93794512. Source: OSTI; NTIS (US Sales Only).

Investigative studies have been carried out since 1987 on crude oil recovery technologies utilizing microorganisms. This paper is a 1991 annual report for the studies. Secondary screening to identify production capability quantitatively has been made on 20 stocks of microorganisms selected by the previous fiscal year (those having been verified to produce gasses, acids, surfactants, and polymers). Cultivating conditions were reviewed on most promising stocks. An oil recovery experiment was begun using TRC separating microorganisms, and so was a discussion on establishing experimental methods and on methods to evaluate oil recovery capability of the separating microorganisms. As a result, several stocks of microorganisms were discovered that have acid producing capability in excess of those having been found in the previous year, for example. It was revealed that the separation bacteria 18-2-a having the highest surfactant and polymer producing capability can maintain the capability without degradation because of freeze-dry storage or successive subcultures. It was also found that passage cultures somewhat raise the capability of producing various kinds of substances, and the optimal culturing conditions thereof were clarified. 7 tabs.

22808 (ETDE/JP-mf–93794512, pp. 259-275) **Heavy oil EOR technology.: EOR field pilot test in the Ikiztepe oil field, Turkey.** Mitsuishi, Y.; Naito, K.; Mori, S.; Harada, T.; Kubo, S.; Urabe, S. Japan National Oil Corp., Tokyo (Japan). 30 Oct 1992. 537p. (In Japanese). In *Record of TRC's activities in the fiscal year 1991.* Order Number DE93794512. Source: OSTI; NTIS (US Sales Only).

The Turkish National Petroleum Corporation (TAPO) and the Japanese Petroleum Public Corporation are conducting field tests as a joint research on the enhanced oil recovery (EOR) technology at the Ikiztepe heavy gravity oil field. The six-year plan for 1988 through 1993 based on the feasibility study in 1987 is being moved forward to a field pilot test. This paper is an annual report on the results during the fiscal year 1991. In the fiscal 1991, the well drilling tests carried out in the previous year continued onto modifying four wells including one waste water treating well and testing additionally three wells. Further, a conduction test was carried out to evaluate fractures recognized between the steam injection well (SI) and a production well (SP1). In addition, 11 wells were given completion works. With respect to oil bed evaluation, three-dimensional oil bed simulations were carried out using the steam method and the carbon dioxide method based on the the then available data, which provided a prospect to an optimum schem. 9 figs., 4 tabs.

22809 (ETDE/JP-mf–93794512, pp. 276-280) **Heavy oil EOR technology.: Well completion technology for EOR field pilot test.** Harada, T.; Kubo, S.; Naito, K.; Mitsuishi, Y. Japan National Oil Corp., Tokyo (Japan). 30 Oct 1992. 537p. (In Japanese). In *Record of TRC's activities in the fiscal year 1991.* Order Number DE93794512. Source: OSTI; NTIS (US Sales Only).

This paper reports the result of researches obtained during the fiscal 1991 on well completion technologies being carried out at the Ikiztepe oil field in Turkey as part of expedited heavy gravity oil recovery technology researches. The objective of the research is to establish an economical and optimal completion technology to solve high-temperature hazards in the steam method and corrosion in the carbon dioxide method. Items of equipment had been installed and materials had been supplied for 13 wells by the previous year, and the completion works were performed in 1991. Specifications for tubing in steam forced wells called for heat insulating dual tubing and expansion joints, 13 Cr materials in carbon dioxide forced wells, and ordinary steel and packerless specifications in the steam method. The completion work encountered a trouble caused from defects in manufacture of the high-temperature resistant packers for the steam forced wells, and the trouble was examined in the following year. But other well completion works have ended smoothly without a large problem. 2 figs., 1 tab.

22810 (ETDE/JP-mf–93794512, pp. 281-285) **Heavy oil EOR technology.: Monitoring technology for EOR process.** Kubo, S.; Harada, T.; Suzuki, K.; Mori, S.; Mitsuishi, Y. Japan National Oil Corp., Tokyo (Japan). 30 Oct 1992. 537p. (In Japanese). In *Record of TRC's activities in the fiscal year 1991.* Order Number DE93794512. Source: OSTI; NTIS (US Sales Only).

This paper reports the result of researches obtained during the fiscal 1991 on test monitoring techniques being carried out at the Ikiztepe oil field in Turkey as part of expedited heavy gravity oil recovery technology researches. In the steam flooding method in particular, measurements are important on quantity of heat applied to an oil bed in addition to the amount and period of time for steam flooding. Therefore, a well bottom dryness measuring apparatus is under development to meet the requirements of measuring temperatures, pressures, and steam dryness. In the fiscal 1991, systems of capillary tube (inner well pressure observing device) and thermocouple (well bottom temperature observing device) were dropped and installed in four steam flooding wells. Only capillary tubes were installed in six carbon dioxide injection wells. Steam dryness measurements used the cadmium ratio measuring system in the density measuring method using neutron logging of which effectiveness had been verified in the previous year, and the prototype II was designed and fabricated to confirm the characteristics. A patent was applied for the density measuring system using neutron logging. 3 figs., 2 tabs.

22811 (ETDE/JP-mf–93794512, pp. 286-292) **Heavy oil EOR technology.: Basic research on a steam flooding process under high pressure and high temperature for whole core.** Kogachi, T.; Taya, Y. Japan National Oil Corp., Tokyo (Japan). 30 Oct 1992. 537p. (In Japanese). In *Record of TRC's activities in the fiscal year 1991.* Order Number DE93794512. Source: OSTI; NTIS (US Sales Only).

Investigations are given on steam scavenging processes with simulated experiment on oil bed rocks as part of the steam flooding pilot test, an international joint research, and researches are made to help evaluate numerical simulations and pilot tests. The experiment forced steam into test cores at a constant pressure, and measured the steam and oil recovered from a core holder outlet. Such troubles experienced up to the previous year as blocking of the outlet by high-viscosity crude oil and improper weighing were improved for the experiment (dualizing the pressure control valve, and shortening and simplifying the piping). Although a preliminary experiment which served also as a start-up operation has eliminated the problems having existed prior to the improvement, the core samples from the Ikizpete oil field did not produce fluids even after a lapse of 25 hours in the main experiment using a pressure of 112 kgf/cm^2 at the forcing side and a pressure differential of 5 to 11 kgf/cm^2 at the outlet. The problem awaiting solution is to elucidate overall influence including the pressure differential setting, the core characteristics, and thermal loss at the holder. 6 figs., 4 tabs.

22812 (ETDE/JP-mf–93794512, pp. 293-303) **Heavy oil EOR technology.: Application of thermal reservoir simulation technology to a steam flood field pilot test in a heavy oil reservoir.** Suzuki, K. Japan National Oil Corp., Tokyo (Japan). 30 Oct 1992. 537p. (In Japanese). In *Record of TRC's activities in the fiscal year 1991.* Order Number DE93794512. Source: OSTI; NTIS (US Sales Only).

With an objective of improving the accuracy in oil bed behavior evaluation, a thermal reservoir simulator was applied to a steam flooding pilot test under progress at an actual oil field. Its processes and results have been discussed. In the fiscal year 1991,

oil bed behavior presented by field data taken during a period of about 700 days and the simulation results were compared and discussed using a full pattern model. Further, influences of uncertain factors including permeability of faults were discussed and compared with the results of physical exploration. A history matching was carried out using a structured basic model. It was verified that the oil bed behavior during the subject period of time can be reproduced nearly completely. A 1-8 symmetry model cannot reproduce such an oil bed condition that the forced steam in this pilot test contributes biasedly. Next, an investigation on sensitivity relating to permeability of faults revealed that the permeability affects little the reproducibility of the simulation. 4 figs., 2 tabs.

22813 (ETDE/JP-mf–93794512, pp. 304-308) **Enhanced oil recovery.: Field pilot test on CO2 flood.** Yasuda, M.; Urabe, S. Japan National Oil Corp., Tokyo (Japan). 30 Oct 1992. 537p. (In Japanese). In *Record of TRC's activities in the fiscal year 1991.* Order Number DE93794512. Source: OSTI; NTIS (US Sales Only).

With objectives to evaluate mechanisms of a tertiary recovery process in the carbon dioxide flooding method and establish a comprehensive technique for actual operation as part of a joint EOR research at IEA, field tests are under progress at the Kubiki oil field in Niigata Prefecture under a five-year plan that started in 1988. This paper is an annual report on results obtained during the fiscal year 1991. Based on the preliminary stage that had been completed by the previous year, carbon dioxide forcing tests were carried out in 1991. Carbon dioxide was forced initially at quantities from 5 tons to 7 tons daily on a trial basis, but the flooding performance has improved gradually up to 15 tons a day. The cumulative amount of flooded gas reached about 4200 tons as of the end of the fiscal 1991. It was revealed from a step rate test that the forcing performance improves as the carbon dioxide forcing progresses over the case of using water. A PI logging verified that residual oil from a water flooding process is moving fluidly as a result of the carbon dioxide flooding, and a CNL logging showed a decrease in porosity inferred to have occurred because of arrival of carbon dioxide. Other laboratory tests have also been conducted. 6 figs., 2 tabs.

22814 (ETDE/JP-mf–93794512, pp. 456-463) **Technologies for offshore marginal oil field development.: Optimization program for SPM system.** Wada, H.; Yokokura, K.; Jingu, N.; Tezuka, N. Japan National Oil Corp., Tokyo (Japan). 30 Oct 1992. 537p. (In Japanese). In *Record of TRC's activities in the fiscal year 1991.* Order Number DE93794512. Source: OSTI; NTIS (US Sales Only).

As a sub-theme for the special research project, 'Technologies for offshore marginal oil field development', a single-point mooring type floating production system was selected suitable for a given condition of oil field at medium depths from 400 m to 500 m. Development works have been carried out on practical programs to analyze motions of the system under a five-year plan from 1990 to 1994. This paper reports the results obtained during the fiscal 1991. The major part of the programs was prepared and a basic plan for verification water tank experiments was planned in the fiscal 1991. Series calculations were performed to expand the optimization data base subsequently to those conducted in the previous year, and new hydrographic data were collected. In preparing the programs, for example, an analytical program was developed for motions and restraining forces on an articulated single-point mooring system in waves, winds, and currents. Also prepared were the programs for analyzing static balance in a turret mooring system, and calculating frequency regions and time regions. 4 figs., 2 tabs.

22815 (ETDE/JP-mf–93794512, pp. 464-472) **Technologies for offshore marginal oil field development.: Optimization program for a new configuration of FPS.** Ohashi, M.; Yokokura, K.; Jingu, N.; Tezuka, N. Japan National Oil Corp., Tokyo (Japan). 30 Oct 1992. 537p. (In Japanese). In *Record of TRC's activities in the fiscal year 1991.* Order Number DE93794512. Source: OSTI; NTIS (US Sales Only).

Based on the trend of offshore oil field development going further into sea areas with severer natural conditions, development efforts are being made on a floating production system using new type vessels equipped with high operation rates and required oil storing capacities. The development works are made as a sub-theme for the special research project, 'Technologies for offshore marginal oil field development' under a five-year plan from 1990 to 1994. This paper reports the results obtained during the fiscal 1991. The following results were achieved during the subject fiscal year according to the long-term research schedule: development of static analysis programs for a platform equipped with a position retaining device; discussions on measures to reduce rolls related to the new vessel shape; water tank experiments to obtain data to discuss the measures; and development of a basic calculation part for the program to analyze rolls of new shape vessels. For instance, in the new type platforms, tests were given on mechanisms of submerged flat plates, protruding fins, aerofoil fins, and open-type roll reducing tanks, as measures to reduce a pitch long-cycle motion which has been a problem in a mono-column shape vessels. 6 figs.

22816 (ETDE/JP-mf–93794512, pp. 473-481) **Technologies for offshore marginal oil field development.: Optimum design method for compliant tower.** Ohashi, M.; Matsui, Y.; Tezuka, N. Japan National Oil Corp., Tokyo (Japan). 30 Oct 1992. 537p. (In Japanese). In *Record of TRC's activities in the fiscal year 1991.* Order Number DE93794512. Source: OSTI; NTIS (US Sales Only).

Noticing a compliant tower among production facilities for oil fields at medium depths, its structural behavior is identified, and its analyzing technologies and optimization technologies are discussed, as a sub-theme for the special research project, 'Technologies for offshore marginal oil field development' under a five-year plan from 1990 to 1995. This paper reports the results obtained during the fiscal 1991. Different types of compliant towers were compared, an optimal concept was selected, and discussions were given on equivalent linearization methods for pile-ground models as well as seismic responses in the fiscal 1991 according to the long-term research schedule. For instance, with respect to the last item, extents of seismic effects were discussed by investigating the effects of seismic responses on the tower and piles, and comparing the responses with wave responses. As a result, it was revealed that seismic analyses are required if installing locations fall under the Zone-4 and Zone-5 in the RP2A 18th section in the API. 6 figs., 5 tabs.

22817 (ETDE/JP-mf–93794512, pp. 482-489) **Technologies for offshore marginal oil field development.: Application of subsea systems.** Tada, Y.; Wada, H.; Shoda, N.; Takehira, S.; Yokokura, K.; Tezuka, N. Japan National Oil Corp., Tokyo (Japan). 30 Oct 1992. 537p. (In Japanese). In *Record of TRC's activities in the fiscal year 1991.* Order Number DE93794512. Source: OSTI; NTIS (US Sales Only).

Discussions are being given on achieving evaluation and optimization of the applicability of a production system using se bottom completing wells, as a sub-theme for the special research project, 'Technologies for offshore marginal oil field development'. This paper reports the results obtained during the fiscal 1991. The research works carried out in the current fiscal year included 'analysis of application records and trends in sea bottom completing systems' and 'investigation on existing technologies and systematization of design methods'. The data base developed by the Subsea Data Services Inc. was used to summarize the current situation and the trends of the systems from the aspects of locations, installing depths, tree types, and control types. Investigation on technical trends was made on those used in North Sea, from which the trends were clarified that design standardization and diver-free technology development are being moved forward positively with emphasis placed on safety and cost. The technology investigation elucidated characteristics of different intervention methods, and problems inherent to completion systems. 4 figs., 2 tabs.

22818 (ETDE/JP-mf–93794512, pp. 490-497) **Technologies for offshore marginal oil field development.: Optimization program for offshore oil field development system.** Tada, Y.; Wada, H.; Shoda, N.; Takehira, S.; Tezuka, N.; Yokokura, K.; Matsui, Y.; Ohashi, M.; Matsuo, T. Japan National Oil Corp., Tokyo (Japan). 30 Oct 1992. 537p. (In Japanese). In *Record of TRC's activities in the fiscal year 1991.* Order Number DE93794512. Source: OSTI; NTIS (US Sales Only).

Establishing evaluation technologies is targetted to optimize systems by means of defining technical applicability and factor calculations on different elementary facilities constituting an offshore oil field development system, as a sub-theme for the special

research project, 'Technologies for offshore marginal oil field development'. The work is being moved forward under a new five-year plan from the 1990 to 1994 fiscal years based on the previously developed 'system selection program (NEPTUNE)', and keeping the pace with further technical progresses. This paper reports the results obtained during the fiscal 1993. Major items of works carried out during the current fiscal year included renewal of the NEPTUNE registered data, collection of technical trend data in the world, selection of development concepts based thereon, as well as concept designs to structure new evaluation aiding systems. From the aspect of software development, for example, a necessity was recognized that the system be structured well balanced in the data control system, the AI tools and the data base. 6 figs.

22819 (ETDE/JP-mf–93794512, pp. 498-502) **Technologies for offshore marginal oil field development.: Flexible production riser system for deep water.** Wada, H.; Tada, Y.; Tezuka, N. Japan National Oil Corp., Tokyo (Japan). 30 Oct 1992. 537p. (In Japanese). In *Record of TRC's activities in the fiscal year 1991*. Order Number DE93794512. Source: OSTI; NTIS (US Sales Only).

Development is being made on light-weight flexible production risers for use in a production system used in medium depth sea areas, as a sub-theme for the special research project, 'Technologies for offshore marginal oil field development'. The development is aimed at reducing weight of the conventional production risers for delivering crude oil produced at sea bottoms to the surface that had a loading problem because of their great weight due to the multi-layer steel structure. The development is being moved forward under a four-year plan that started in the 1990 fiscal year. During the fiscal 1991, two prototype risers using fiber reinforced plastics (FRP) in the shaft force reinforcing layer and another two prototypes using high strength steels in the reinforcing layer were fabricated. The two types of FRP reinforced risers were verified capable of withstanding a design pressure of 350 kg/cm^2. Good results were obtained also on the methods of attaching terminal joints to the risers. Also carried out was a water tank experiment simulating a water depth of 400 m to evaluate stability of the riser shapes, investigate problems in the installing techniques, and discuss methods to analyze riser side pressures. 4 figs.

22820 (GBHW–93013128) **[Branched horizontal well drilling].** Grigoryan, A.M. Grigoryan Branched-Horizontal Wells Co., Los Angeles, CA (United States). [1993]. 14p. Source: OSTI; Grigoryan Branched-Horizontal Wells Co., 1637 N. Vine St., Suite 916, Los Angeles, CA 90028.

In the former USSR, invented the technology of drilling and brought the industrial level a new type of oil wells - Grigoryan Branched-Horizontal wells. Tens of experimental wells had been drilled and successfully operated for a long period of time. The technology itself is unique, it was developed in isolation from the West and has left far behind all known methods by its effectiveness and technical characteristics. A single hole horizontal drilling which is being now applied all around the world is a small part of this method. A branched well has several additional holes with their branches. Such well is incomparably more effective than single horizontal hole as the branches penetrate in all directions the whole mass of productive formation by their canals free for oil inflow from distant zones, often isolated. In modern application this method enables to get wells with up to 20 times higher production rates and simultaneously 5 times less oil production costs. In order to commercialize technology a "Grigoryan Branched-Horizontal wells Co." is being established for the development of oil fields, on ownership, lease or contractor basis. The Branched-Horizontal wells are especially effective in high thickness oil reservoirs with highly irregular porosity and rock permeability where the percentage of oil recovery is low while the potential reserves are very large. If in such a field oil Production of conventional well is only 10–20 ton (60–180 barrels) per day, one Branched-Horizontal well will produce an additional 10 million dollars worth of oil even during the first year of operation. This is the oil extracted from the bowels of the earth above the capacity of ordinary wells and inaccessible for them. Taking into consideration the fact that on average, only 20% of natural resources are being extracted around the world, the main advantage of this method is in doubling the recoverable reserves thus moving far ahead the predicted exhaustion of fossil hydrocarbons.

22821 (LA-SUB–93-121) **Pore scale flow and examination of the effects of scaling on improved oil recovery processes: Final report.** Kovarik, F.S. (Houston Univ., TX (United States). Inst. for Improved Oil Recovery Research); Owusu, L. Los Alamos National Lab., NM (United States); Houston Univ., TX (United States). Inst. for Improved Oil Recovery Research. Apr 1991. 55p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. Order Number DE93012074. Source: OSTI; NTIS; GPO Dep.

All project goals have been satisfied including. (1) Digitizable images of pore networks have been developed. (2) Video tapes of immiscible and miscible micromodel experiments at reservoir conditions were created. (3) High-pressure, flow visualization apparatus design and high pressure coreflood design are presented. Methodology for understanding 2-D to 3-D scaleup phenomena at the pore-level is demonstrated. (4) Micromodel experiments were simulated with the new multi-porosity, natural fracture oil reservoir simulator. This information will be used in the further development of a new, predictive, oil and gas reservoir simulator which is based upon lattice gas methods. The long range goal for this project is to develop for the independent oil and gas producers in the US a better predictive tool for the determination of oil and gas reservoir performance throughout the life of the field. This information is critically important for the independent to determine correctly the risk of his investment to develop and produce the field.

22822 (NIPER–578) **Feasibility study of heavy oil recovery in the Permian Basin (Texas and New Mexico).** Olsen, D.K.; Johnson, W.I. National Inst. for Petroleum and Energy Research, Bartlesville, OK (United States). May 1993. 37p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC22-83FE60149. Order Number DE93000141. Source: OSTI; NTIS; INIS; GPO Dep.

This report is one of a series of publications assessing the feasibility of increasing domestic heavy oil production. Each report covers select areas of the United States. The Permian Basin of West Texas and Southeastern New Mexico is made up of the Midland, Delaware, Val Verde, and Kerr Basins; the Northwestern, Eastern, and Southern shelves; the Central Basin Platform, and the Sheffield Channel. The present day Permian Basin was one sedimentary basin until uplift and subsidence occurred during Pennsylvanian and early Permian Age to create the configuration of the basins, shelves, and platform of today. The basin has been a major light oil producing area served by an extensive pipeline network connected to refineries designed to process light sweet and limited sour crude oil. Limited resources of heavy oil (10° to 20° API gravity) occurs in both carbonate and sandstone reservoirs of Permian and Cretaceous Age. The largest cumulative heavy oil production comes from fluvial sandstones of the Cretaceous Trinity Group. Permian heavy oil is principally paraffinic and thus commands a higher price than asphaltic California heavy oil. Heavy oil in deeper reservoirs has solution gas and low viscosity and thus can be produced by primary and by waterflooding. Because of the nature of the resource, the Permian Basin should not be considered a major heavy oil producing area.

22823 (NIPER–663) **Imaging techniques applied to the study of fluids in porous media: Scaling up in Class 1 reservoir type rock.** Tomutsa, L.; Brinkmeyer, A.; Doughty, D. National Inst. for Petroleum and Energy Research, Bartlesville, OK (United States). Apr 1993. 44p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC22-83FE60149. Order Number DE93000135. Source: OSTI; NTIS; GPO Dep.

A synergistic rock characterization methodology has been developed. It derives reservoir engineering parameters from X-ray tomography (CT) scanning, computer assisted petrographic image analysis, minipermeameter measurements, and nuclear magnetic resonance imaging (NMRI). This rock characterization methodology is used to investigate the effect of small-scale rock heterogeneity on oil distribution and recovery. It is also used to investigate the applicability of imaging technologies to the development of scaleup procedures from core plug to whole core, by comparing the results of detailed simulations with the images ofthe fluid distributions observed by CT scanning. By using the rock and fluid detailed data generated by imaging technology describe, one can verify directly,

in the laboratory, various scaling up techniques. Asan example, realizations of rock properties statistically and spatially compatible with the observed values are generated by one of the various stochastic methods available (fuming bands) and are used as simulator input. The simulation results were compared with both the simulation results using the true rock properties and the fluid distributions observed by CT. Conclusions regarding the effect of the various permeability models on waterflood oil recovery were formulated.

22824 (NIPER–686) **Monthly progress report for April 1993.** National Inst. for Petroleum and Energy Research, Bartlesville, OK (United States). May 1993. 60p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC22-83FE60149. Order Number DE93014219. Source: OSTI; NTIS; GPO Dep.

Accomplishments for the month of April are described briefly for the following tasks: energy production research; fuels research; and supplemental government program. Energy production research includes: reservoir assessment and characterization; TORIS research support; development of improved microbial flooding methods; development of improved chemical flooding methods; development of improved alkaline flooding methods; mobility control and sweep improvement in chemical flooding; gas flood performance prediction improvement; mobility control, profile modification, and sweep improvement in gas flooding; three-phase relative permeability research; thermal processes for light oil recovery; thermal processes for heavy oil recovery; and imaging techniques applied to the study of fluids in porous media. Fuel research includes: development of analytical methodology for analysis of heavy crudes; and thermochemistry and thermophysical properties of organic nitrogen- and diheteratom-containing compounds. Supplemental government program includes: microbial-enhanced waterflooding field project; feasibility study of heavy oil recovery in the midcontinent region–Oklahoma, Kansas, and Missouri; surfactant-enhanced alkaline flooding field project; process- engineering property measurements on heavy petroleum components; development and application of petroleum production technologies; upgrade BPO crude oil data base; simulation analysis of steam-foam projects; DOE education initiative project; field application of foams for oil production symposium; technology transfer to independent producers; compilations and analysis of outcrop data from the Muddy and Almond Formations; implementation of oil and gas technology transfer initiative; and horizontal well production from fractured reservoirs.

22825 (SAND–92-1711) **Analysis of sucker rod and sinkerbar failures.** Waggoner, J.R.; Buchheit, R.G. Sandia National Labs., Albuquerque, NM (United States). Mar 1993. 47p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. Order Number DE93013600. Source: OSTI; NTIS; GPO Dep.

This report presents results of a study of performance and failures of the sucker rod/sinkerbar string used in beam-pumping operations through metallography, finite element analysis, and failure data collection. Metallography showed that the microstructure of the steel bar stock needs to be considered to improve the fatigue resistance of the sucker rod strings. The current specification based on tensile strength, or yield strength, may not be appropriate since failure occurs because of fatigue and not yielding, and tensile strength is not always a good measure of fatigue resistance. Finite element analysis of the threaded connection quantitatively assesses the coupling designs under various loading conditions. Subcritical fractures in metallography are also suggested by calculated stress distribution in threaded coupling. Failure data illustrates both magnitude and frequency of failures, as well as categorizing the suspected cause of failure. Application of the results in each of these project areas is expected to yield improved choice of metal bar stock, thread design, and make-up practices which can significantly reduce the frequency of sucker rod failures. Sucker rod failures today are not inherent in the process, but can be minimized through the application of new technology and observation of common-sense practices.

0204 Processing

Refer also to citation(s) 22717, 23872, 24033

22826 (BNL–48524) **Fuel quality issues in the oil heat industry.** Litzke, Wai-Lin. Brookhaven National Lab., Upton, NY (United States). Dec 1992. 29p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. Order Number DE93011644. Source: OSTI; NTIS; GPO Dep.

The quality of fuel oil plays an essential role in combustion performance and efficient operation of residential heating equipment. With the present concerns by the oil-heat industry of declining fuel-oil quality, a study was initiated to identify the factors that have brought about changes in the quality of distillate fuel. A background of information will be provided to the industry, which is necessary to deal with the problems relating to the fuel. The high needs for servicing heating equipment are usually the result of the poor handling characteristics of the fuel during cold weather, the buildup of dirt and water in storage tanks, and microbial growth. A discussion of how to deal with these problems is presented in this paper. The effectiveness of fuel additives to control these problems of quality is also covered to help users better understand the functions and limitations of chemical treatment. Test data have been collected which measure and compare changes in the properties of fuel using selected additives.

22827 (CONF-9207203–, pp. 219-222) **Suppression of product coke in the hydrotreating process of heavy oil.** Tsumura, O. (Idemitsu Kosan Co. Ltd., Tokyo (Japan)); Kato, K.; Okano, A.; Shimizu, T.; Tanaka, R. 22 Jul 1992. 320p. (In Japanese). From 1. meeting of The Japan Institute of Energy and the 70th Foundation anniversary meeting; Tokyo (Japan); 22-24 Jul 1992. In *Proceedings of the 1st Meeting of the Japan Institute of Energy and the 70th Foundation Anniversary Meeting.* Order Number DE93793523. Source: OSTI; NTIS (US Sales Only).

Heavy oil and sand oil produce coke during hydrotreating and refining processes and tend to aggravate the operability and economic effect. Accordingly, discussions were given on relationship between properties of depressurization residual fraction (525°C$^+$; VR) and coke production amount, and methods to reduce the coke production. The heavy oil selected was the one produced at Lloydminster in Canada (Ld), which was compared with heavy oil of Middle East origin (AH). The VR-Ld had higher density, viscosity and V/Ni than the VR-AH, and contained two times as much of resin and asphaltene considered to be coke precursors. Hydrogen donating fraction was added into the heavy oil to perform a pylolytic experiment in an autoclave. The result was that when depressurized light oil is mixed in the VR, the coke production was reduced at more than the dilution effect. This was thought because partial structure with shuttle effect in the depressurized light oil accelerates migration of gaseous hydrogen, and gives hydrogen stabilization to radicals in the asphaltene. 7 figs., 6 tabs.

22828 (CONF-9207203–, pp. 223-226) **Application of HSC residue for in-plant boiler fuel.** Otsubo, T. (Mitsui Kosan Chemicals Co. Ltd., Tokyo (Japan)); Fukuyama, H. 22 Jul 1992. 320p. (In Japanese). From 1. meeting of The Japan Institute of Energy and the 70th Foundation anniversary meeting; Tokyo (Japan); 22-24 Jul 1992. In *Proceedings of the 1st Meeting of the Japan Institute of Energy and the 70th Foundation Anniversary Meeting.* Order Number DE93793523. Source: OSTI; NTIS (US Sales Only).

The high conversion soaker cracking (HSC) developed as a high decomposition visbreaker has a long operation history also as a commercial plant. This paper reports the features of the process and application of HSC residue for in-plant boiler fuel. The process has advanced one step ahead of the conventional visbreaking process and realized higher decomposition rates to obtain the residue in stable liquid state. The process features that pyrolysis is carried out in a normal pressure soaker drum with long residence time and sufficient steam blown in; a multi-stage bubble column of gas-liquid counterflow type is used in the reactor to keep the gas and air in good contact; and their mixing in an axial direction is suppressed. The S oil refinery having operated the system for three and half years converts heavy oil into gasoline, and at the same time supplies the residue to a power generation plant located 2 km away,

where the residue is used stably and efficiently as fuel. 2 figs., 2 tabs.

22829 (CONF-9207203–, pp. 233-234) **Study on cyclic gasification catalyst. 2.** Uchida, H. (Tokyo Gas Co. Ltd., Tokyo (Japan)). 22 Jul 1992. 320p. (In Japanese). From 1. meeting of The Japan Institute of Energy and the 70th Foundation anniversary meeting; Tokyo (Japan); 22-24 Jul 1992. In *Proceedings of the 1st Meeting of the Japan Institute of Energy and the 70th Foundation Anniversary Meeting.* Order Number DE93793523. Source: OSTI; NTIS (US Sales Only).

This paper reports a summary of development of a nickel-based catalyst having excellent activity and durability to be used in a cyclic gasification equipment for manufacturing city gases. A trial fabrication was carried out of a support containing CaO-6Al2O3 and SrO-6Al2O3, a composite oxide of alkali earth metal and aluminum (hereinafter the support A) and a catalyst with mullite (2SiO2-3Al2O3) support loaded with nickel oxide at 5%. It was found that the catalyst with the support A has heat resistance that can maintain a large surface area even under elevated temperatures and as large catalyst specific area as 8 m^2 when compared to that of 1 m^2 in conventional silica and alumina supports, which provided good dispersion of activated metals. To explain, in a steaming test at 800°c for 15 hours, production of nickel aluminate which can cause thermal degradation was less, and in butane gasification test, the gas productivity and selectivity were superior. 3 refs., 2 figs., 1 tab.

22830 (CONF-9207203–, pp. 235-236) **Development of efficient desulfurization process of diesel fuel using oxidation reaction.** Aida, T. (Kinki University, Osaka (Japan). Faculty of Engineering); Ito, T.; Sakata, K. 22 Jul 1992. 320p. (In Japanese). From 1. meeting of The Japan Institute of Energy and the 70th Foundation anniversary meeting; Tokyo (Japan); 22-24 Jul 1992. In *Proceedings of the 1st Meeting of the Japan Institute of Energy and the 70th Foundation Anniversary Meeting.* Order Number DE93793523. Source: OSTI; NTIS (US Sales Only).

In a situation that different types of efficient desulfurization process are studied, this paper discusses application of the coal oxidation-alkaline decomposition process developed as reported in the previous papers. The process oxidizes selectively organic sulfur component in coal and separates it utilizing changes in its physicochemical properties. For example, when dimethyl sulfide is oxidized into dimethyl sulfoxide, its boiling point changes largely from 38°C to 189°C, and it becomes water soluble. These changes could occur to benzothiophene in light oil or dibenzothiophene derivatives. Accordingly, as a result of oxidizing light oil in a formic acid/hydrogen peroxide system and comparing GC chart distributions of sulfur component before and after the oxidation, noticeable changes were recognized in the boiling point and the polarity in organic sulfur compound. This oxidized oil was desulfurized using distillation, solvent extraction, adsorption and separation, where a sulfur content of 0.05% was achieved easily. 2 refs., 2 figs.

0205 Products and By-Products

Refer also to citation(s) 22668

0207 Economic, Industrial, and Business Aspects

Refer also to citation(s) 22822, 22841, 22842

22831 (DOE/BC/14853–3) **Continued support of "The Natural Resources Information System (NRIS) for the State of Oklahoma": Quarterly technical progress report, January 1, 1993–March 31, 1993.** Mankin, C.J. (Oklahoma Geological Survey, Norman, OK (United States)); Rizzuti, T.P. Oklahoma Geological Survey, Norman, OK (United States). 1993. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-92BC14853. Order Number DE93014642. Source: OSTI; NTIS; GPO Dep.

The objective of this research program is to continue developing, editing, maintaining, utilizing and making publicly available the Oil and Gas Well History file portion of the Natural Resources Information System (NRIS) for the State of Oklahoma. The Oklahoma Geological Survey, working with Geological Information Systems at the University of Oklahoma Sarkeys Energy Center, has undertaken to construct this information system in response to the need for a computerized, centrally located library containing accurate, detailed information on the state's natural resources. Particular emphasis during this phase of NRIS development is being placed on computerizing information related to the energy needs of the nation, specifically oil and gas. The NRIS Well History file contains historical and recent completion records for oil and gas wells reported to the Oklahoma Corporation Commission on Form 1002-A. At the start of this quarter, the Well History file contained 283,751 records, providing geographical coverage for most of Oklahoma (all but the northeast part of the State). Data elements on this file include API well number, lease name and well number, location information, elevations, dates of significant activities for the well and formation items (e.g., formation names, completion and test data, depths and perforations). In addition to the standard Well History file processing, special projects are undertaken to add supplemental data to the file from well logs, scout tickets, and core and sample documentation.

22832 (DOE/EIA–0109(93/04)) **Petroleum supply monthly, April 1993.** USDOE Energy Information Administration, Washington, DC (United States). Office of Oil and Gas. 4 May 1993. 178p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93013203. Source: OSTI; NTIS; GPO; GPO Dep.

The Petroleum Supply Monthly (PSM) is one of a family of four publications produced by the Petroleum Supply Division within the Energy Information Administration (EIA) reflecting different levels of data timeliness and completeness. The other publications are the Weekly Petroleum Status Report (WPSR), the Winter Fuels Report, and the Petroleum Supply Annual (PSA). Data presented in the PSM describe the supply and disposition of petroleum products in the United States and major US geographic regions. The data series describe production, imports and exports, inter-Petroleum Administration for Defense (PAD) District movements, and inventories by the primary suppliers of petroleum products in the United States (50 States and the District of Columbia). The reporting universe includes those petroleum sectors in primary supply. Included are: petroleum refiners, motor gasoline blenders, operators of natural gas processing plants and fractionators, inter-PAD transporters, importers, and major inventory holders of petroleum products and crude oil. When aggregated, the data reported by these sectors approximately represent the consumption of petroleum products in the United States. Data presented in the PSM are divided into two sections: Summary Statistics and Detailed Statistics.

22833 (DOE/EIA–0130(93/04)) **Natural gas monthly, April 1993.** USDOE Energy Information Administration, Washington, DC (United States). Office of Oil and Gas. 3 May 1993. 149p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93012896. Source: OSTI; NTIS; GPO; GPO Dep.

The Natural Gas Monthly (NGM) highlights activities, events, and analyses of interest to public and private sector organizations associated with the natural gas industry. Volume and price data are presented each month for natural gas production, distribution, consumption, and interest pipeline activities. Producer-related activities and underground storage data are also reported. From time to time, the NGM features articles designed to assist readers in using and interpreting natural gas information. This month's feature article is titled Revisions to Monthly Natural Gas Data.

22834 (DOE/EIA–0520(93/04)) **International petroleum statistics report, April 1993.** USDOE Energy Information Administration, Washington, DC (United States). Office of Energy Markets and End Use. 29 Apr 1993. 62p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93013129. Source: OSTI; NTIS; GPO; GPO Dep.

The International Petroleum Statistics Report presents data on international oil production, demand, imports, exports, and stocks. The report has four sections. Section 1 contains time series data on world oil production, and on oil demand and stocks in the Organization for Economic Cooperation and Development (OECD). This section contains annual data beginning in 1980, and monthly data for the most recent two years. Section 2 presents an oil supply/demand balance for world. This balance is presented in quarterly

intervals for the most recent two years. Section 3 presents data on oil imports by OECD countries. This section contains annual data for the most recent year, quarterly data for the most recent two quarters, and monthly data for the most recent twelve months. Section 4 presents annual time series data on world oil production and oil stocks demand and trade in OECD countries. World oil production and OECD demand data are for the years 1970 through 1991; OECD stocks from 1973 through 1991; and OECD trade from 1982 through 1991.

22835 (ETDE/JP-mf–93794512) **Record of TRC's activities in the fiscal year 1991.** Japan National Oil Corp., Tokyo (Japan). 30 Oct 1992. 537p. (In Japanese). Order Number DE93794512. Source: OSTI; NTIS; Available from Japan National Oil Corp., 2-2, Uchisaiwaicho 2-chome, Chiyoda-ku, Tokyo, Japan.

Since its foundation in 1972, the Technology Research Center has been continuing with various activities to perform centrally and comprehensively introduction of new technologies, development and improvement of existing technologies, technical transfer, technical services, and engineer training as a core organization to support petroleum developing technologies in Japan. The present paper is a record of these activities, covering organizations, budgets, facilities, research operations to education and training operations, and internationally cooperative research operations. The research and development operations implemented and created results during the fiscal 1991 include: eight themes including the 'microorganism EOR technology' as the working research program; nine themes including the 'surface geochemical technology for mine probing' as the large-scale research program; and six themes including the 'well stimulation technology' as the special research program. The education and training operations opened in succession to those in the previous year three courses for mine prospecting, oil bed engineerings, and geology and geochemistry inviting 49 engineers from 19 nations. International joint researches in cooperation with organizations in other countries were also conducted actively including invitation of 11 persons and long-term dispatch of 5 persons.

22836 (IFP–40394-1) **The world economy of petroleum products and the strategy of a petroleum company from exporting country: Cases of SONATRACH (Algeria), KPC (Kuwait), PEMEX (Mexico), PDVSA (Venezuela). First volume.** Preure, M. Institut Francais du Petrole (IFP), 92 - Rueil-Malmaison (France); Technip, 92 - Rueil-Malmaison (France). Dec 1992. [320p.] (In French). Order Number DE93626477. Source: OSTI; NTIS (US Sales Only); INIS.

This thesis contains 2 volumes. In this first volume, the author describes in a first part the world economy of petroleum and natural gas products: Historical aspects and relationships between the different actors; General structure of the world economy of petroleum and gas products and actual trends. In a second part, the relationships between petroleum products, national economic development and problem of technology conservation are studied. The cases of Algeria, Kuwait, Mexico and Venezuela are given. 258 refs., 103 tabs.

22837 (IFP–40394-2) **The world economy of petroleum products and the strategy of a petroleum company from exporting country: Cases of SONATRACH (Algeria), KPC (Kuwait), PEMEX (Mexico), PDVSA (Venezuela). Second volume.** Preure, M. Institut Francais du Petrole (IFP), 92 - Rueil-Malmaison (France); Technip, 92 - Rueil-Malmaison (France). Dec 1992. [388p.] (In French). Order Number DE93626478. Source: OSTI; NTIS (US Sales Only); INIS.

This thesis contains 2 volumes. In this second volume, the author describes the industrial and technological developments and the strategy of petroleum companies in exporting countries. The main industrial strategies studied are national integration strategy in a planned economy (case of Algeria) or in a controlled-liberal economy (case of Mexico) and international integration strategies to the lower part of petroleum industry and external growth (cases of Kuwait and Venezuela). Technological strategies studied are development of a national engineering, information, research programs/development and innovation. The last chapter takes stock of research and development programs for petroleum products (case of Mexico) . 258 refs., 103 tabs.

0208 Waste Management

22838 (DOE/MT/92007–2) **Characterization of oil and gas waste disposal practices and assessment of treatment costs engineering: [Quarterly] report, January 1, 1993–March 31, 1993.** Bedient, P.B. Rice Univ., Houston, TX (United States). Dept. of Environmental Sciences and Engineering. 22 Apr 1993. 19p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-92MT92007. Order Number DE93014604. Source: OSTI; NTIS; GPO Dep.

This report covers work completed during the third quarter for the project. The project consists of three tasks: the first relates to developing a database of waste volumes and disposal methods used by theindustry; the second and third-tasks are aimed at investigating technologies that could be used for the treatment of produced waters and developing cost estimates for those technologies. Efforts in the past quarter were aimed at finalizing the design of the planned survey for this project. The selected design divides the survey by topic into three sections: (1) drilling wastes; (2) associated wastes; and (3) producedwater. A literature survey of the environmental impacts of oil and gas activities was conducted. Maps of oil and gas fields in each state were compiled. To date, maps for the following states have been received: Alabama, Alaska, Arkansas, California, Colorado, Michigan, Montana, Nevada, New York, North Dakota, Ohio, Oklahoma, Pennsylvania, South Dakota, Tennessee, Utah, and Wyoming. Maps from other states are being pursued. During the past quarter, contact was made with several individuals thought to have some pertinent information regarding this project. Most notable among the material received was a study conducted by Remediation Technologies, Inc. in conjunction with Gas Research Institute that was used to develop management strategies to handle environmental problems encountered in the natural gas production industry. This study has provided a blueprint for the spreadsheet based model that win compute the costs of waste management scenarios in an iterative fashion for this project.

22839 (DOE/MT/92008–1) **Development of a cost-effective environmental compliance technology for stripper well brines: Quarterly report, October 1, 1992–December 31, 1992.** Adewumi, M.A.; Watson, R.W. Pennsylvania State Univ., University Park, PA (United States). Dept. of Mineral Engineering. 1992. 26p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-92MT92008. Order Number DE93014602. Source: OSTI; NTIS; GPO Dep.

In order to demonstrate to the EPA that both from both stripper oil and marginal gas wells in the Appalachain Basin are capable of being treated and disposed of by discharge to streams in an effort on stripper oil well brines will be continued and expanded to examine the range of brines produced from marginal gas wells. The specific object of the research is to demonstrate that the characteristics of wastewater from stripper oil wells and marginal gas wells are sufficiently similar to be treated under a standardized treatment methodology, that the environmental impacts of the discharge of treated brines from both stripper oil and marginal wells can be adequately regulated, and that the inclusion of marginal gas wells in the same category as stripper oil wells is appropriate especially for wells operating in the Appalachian Basin. During this quarter, work on the critical pH studies was completed and work was initiated on determining the catalytic effect of one metal on another. In particular, the studies of copper's effect on aluminum were completed. This series of tests proved that the experimental techniques used for the measurement of catalytic effects are effective.

22840 (DOE/MT/92008–2) **Development of a cost effective environment compliance technology for stripper brine wells: [Quarterly] report, January 1, 1993–March 31, 1993.** Adewumi, M.A.; Watson, R.W.; Tian, S.; Heckman, S.; Safargar, S. Pennsylvania State Univ., University Park, PA (United States). Dept. of Mineral Engineering. 17 May 1993. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-92MT92008. Order Number DE93014603. Source: OSTI; NTIS; GPO Dep.

The specific objective of the research is to demonstrate that the characteristics of wastewater from stripper oil wells and marginal gas wells are sufficiently similar to be treated under a standardized treatment methodology, that the environmental impacts of the discharge of treated brines from both snipper oil and marginal gas

wells can be adequately regulated, and that the inclusion of marginal gas wells in the same category as stripper oil wells is appropriate, especially for wells operating in the Appalachian Basin. During this reporting period, the catalytic effect studies were completed including the effect of copper on lead and zinc as well as the effects of lead and zinc as catalysts. The field studies were to be extended to investigate the system's effectiveness in removing organics as well as the other heavy metals. The major accomplishment during this quarter was establishing the system's effectiveness in removing organics from the field brines. The supporting data are presented in this report.

22841 (DOE/MT/92009–T1) **Evaluation of the freeze-thaw/evaporation process for the treatment of produced waters: Quarterly technical progress report, January 1–March 31, 1993.** Boysen, J.; Morotti, J. Resource Technology Corp., Laramie, WY (United States). Apr 1993. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-92MT92009. Order Number DE93014508. Source: OSTI; NTIS; GPO Dep.

Water purification by using natural conditions to promote freezing appears to be an extremely attractive freeze-crystallization process for the treatment of contaminated water in many areas where natural climatic conditions will seasonally promote freezing. The natural freezing process can be coupled with natural evaporative processes to treat oil and gas produced waters year round in regions with favorable climatic conditions. The objectives of this research are related to development of a commercially-economic natural freeze-thaw/evaporation (FTE) process for the treatment and purification of water produced in conjunction with oil and gas. During the reporting period of 1/1/93 to 3/31/93, project research concentrated on the completion of the Task 1 Summary Report. Task 1 objectives to develop an economic model and determine the commercial viability, economically significant parameters, and research issues of the FTE process have been achieved. Regulatory requirements and associated costs for an FTE facility were found to be similar to those of conventional processes. Two benefits of the FTE process, that make it more environmentally acceptable are: (1) the treated water may be beneficially used and (2) the volume of brine disposal is small compared to disposal of the production water by conventional methods. Based upon the results of the economic evaluation, the FTE process is commercially feasible if operated as described in the base case scenario. In fact, current disposal cost data acquired in Subtask 1.3 indicates the base case water treatment cost of $0.20/bbl is very favorable, less than one-third of the current costs independent producers are paying for disposal at a commercial injection well.

0209 Environmental Aspects

Refer also to citation(s) 24649, 24723, 24745, 24746, 24747

22842 (DOE/MT/92001–3) **Environmental and economic assessment of discharges from Gulf of Mexico region oil and gas operations: Quarterly technical progress report, 1 January–31 March 1993.** Gettleson, D.A. Continental Shelf Associates, Inc., Jupiter, FL (United States). 22 Apr 1993. 22p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-92MT92001. Order Number DE93014606. Source: OSTI; NTIS; GPO Dep.

Task 3 (Environmental Field Sampling and Analysis of NORM, Heavy Metals, and Organics) activities included the continuation of the platform selection process. A revised sampling plan and a projected cost estimate were prepared for Task 3. A letter detailing the revised plan was sent to the Scientific Review Committee (SRC). Task 4 (Monitoring of the Recovery of Impacted Wetland and Open Bay Produced Water Discharge Sites in Coastal Louisiana and Texas) activities involved receiving the final approval for sampling two facilities and requesting approval for a third alternative facility. A revised Task 4 sampling plan and projected estimated costs were prepared. The sampling plan was presented to the SRC for comment. Mobilization activities for the first quarterly sampling were initiated. Task 5 (Assessment of Economic Impactsof Offshore and Coastal Discharge Requirements on Present and Future Operations in the Gulf of Mexico Region) activities included refining the model for estimating the impact of increased environmental compliance costs on remaining reserves in coastal and offshore fields. Task 6 (Synthesis of Gulf of Mexico Seafood Consumption and Use Patterns) activities involved completion and field testing of most survey forms. Retail surveys were initiated and contacts were made with the Vietnamese community. Task 7 (Technology Transfer Plan) work has included scheduling the presentation of information concerning this project at the DOE Contractor Review Meeting in July in Oklahoma. Task 8 (Project Management and Deliverables) activities have involved the submission of the necessary reports and routine management.

22843 (NEI-NO–338) **Environmental program. Phase 1: Summary report.** Oljeindustriens Landsforening, Stavanger (Norway). Dec 1991. 32p. (In Norwegian). Order Number DE93794943. Source: OSTI; NTIS; INIS.

The Norwegian Oil Industry Association (OLF) has initiated an environmental program that has been carried out in cooperation with the Ministry of Petroleum and Energy and the Ministry of the Environment. The program is directed towards emissions to air and discharges to sea from Norwegian offshore oil and gas production operations. The objective is to elucidate the relation between environmental improvements and the costs attached to these improvements. The program is carried through in two phases. In phase 1, emissions and discharge quantities from the industry were established, ongoing studies and research work among the OLF member companies were mapped, and an initial evaluation of emission and discharge reduction measures was performed. Phase 1 also recommended areas to be further evaluated in phase 2. 10 figs., 8 tabs.

22844 (NEI-NO–339) **Environmental program. Phase 2: Summary report.** Oljeindustriens Landsforening, Stavanger (Norway). Mar 1993. 134p. Order Number DE93794945. Source: OSTI; NTIS; INIS.

The Norwegian Oil Industry Association (OLF) has between 1991 and 1993 conducted an environmental program. The objectives were to: Enhance the knowledge of emissions to air and discharges to sea from Norwegian offshore oil and gas production operations. Evaluate the technology and the associated costs for potential reduction of continuous emissions and discharges. Phase 2 of the program has in particular focused on the relationship between the cost and benefit of emission and discharge reduction measures. The purpose has been to identify the measures giving the largest reductions per unit cost. This has now been performed and is documented in 24 technical reports. Total production of oil and gas from the Norwegian sector was 130 million tons oil equivalents (toe) in 1992, most of which was exported to markets in Europe. All this will ultimately be consumed, primarily through energy conversion processes, with release of CO_2 and other greenhouse emission gases. The current gas production of 26 million toe per year will increase rapidly during the coming ten years, while the present increase in oil production is expected to culminate in the same period. Reduction of atmospheric emissions from the Norwegian oil and gas industry may be achieved primarily through energy efficiency measures. Approximately 2.5% of the fossil fuel energy is consumed in the production and transportation process. Different environmental standards between producing nations will primarily affect production cost. The competitiveness of the various producing regions, rather than the overall environmental impact of the petroleum industry and its products, will be effected. 36 refs., 61 figs., 33 tabs.

22845 (UCRL-JC–109677) **Bacterial distribution and metabolic activity in subsurface sediments from a gasoline spill.** Krauter, P.W.; Hanna, M.L.; Taylor, R.T.; Rice, D.W. Jr. Lawrence Livermore National Lab., CA (United States). May 1992. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-920851–92: Spectrum '92: nuclear and hazardous waste management international topical meeting, Boise, ID (United States), 23-27 Aug 1992). Order Number DE93012505. Source: OSTI; NTIS; INIS; GPO Dep.

At the Lawrence Livermore National Laboratory (LLNL) in California, a records inspection in 1979 indicated an inventory of about 17,500 gal was missing from underground fuel tanks. A leak or leaks in the southernmost tank and/or pipe lines were suspected to be the source of the loss. All four tanks were taken out of service

and filled with sand in 1980. The gasoline spill cleanup effort affords an opportunity to study the collective effect of fuel hydrocarbons (HCs) on the indigenous microbial population within the heterogeneous alluvial subsurface environment. This paper presents the early results of an ongoing study to (1) characterize naturally acclimated microbial populations capable of transforming HCs and (2) understand the effects of environmental factors on these biotransformations.

0220 Transport, Handling, and Storage

22846 (DOE/MT/92012–3) **Evaluation of using cyclocranes to support drilling and production of oil and gas in wetland areas: Third quarterly technical progress report, First quarter, 1993.** Eggington, W.J. Mission Research Corp., San Diego, CA (United States). [1993]. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-92MT92012. Order Number DE93014605. Source: OSTI; NTIS; GPO Dep.

The planned program falls under wetlands area research related to drilling, production, and transportation of oil and gas resources. Specifically the planned program addresses an evaluation of using cyclocraft to transport drill rigs, mud, pipes and other materials and equipment in a cost effective and environmentally safe manner to support oil and gas drilling and production operations in wetland areas. The cyclocraft is a proven hybrid aircraft that utilizes aerostatic and aerodynamic lift. This type of aircraft has considerable payload capacity, VTOL capability, high controllability, low operating cost, low downwash and high safety. The benefits of using a cyclocraft to transport drill rigs and materials over environmentally-sensitive surfaces would be significant. The cyclocraft has considerable cost and operational advantages over the helicopter. The major activity during the report period was focussed on Task 4, Preliminary Design. The selected design has been designated H.1 Cyclocraft by MRC. The preliminary design work was based on the results of the three preceding tasks. A report was initiated that contains descriptions of the H.1 Cyclocraft and its subsystems; options available for the final aircraft design process; performance, geometry, weights and power data; logistics and considerations relating to cyclocraft operations in wetlands.

0230 Properties and Composition

Refer also to citation(s) 22824

0250 Combustion

Refer also to citation(s) 22770, 23855, 24511

22847 (CONF-9207203–, pp. 65) **Spray characteristics in spray combustion.** Hiroyasu, H. (Hiroshima University, Hiroshima (Japan). Faculty of Engineering). 22 Jul 1992. 320p. (In Japanese). From 1. meeting of The Japan Institute of Energy and the 70th Foundation anniversary meeting; Tokyo (Japan); 22-24 Jul 1992. In *Proceedings of the 1st Meeting of the Japan Institute of Energy and the 70th Foundation Anniversary Meeting.* Order Number DE93793523. Source: OSTI; NTIS (US Sales Only).

Study was made of spray characteristics influential on the combustion of liquid fuel. Because of non-luminous flame combustion without producing soot, introduction was made of not conventional swirling combustor but non-luminous flame combustor which jetted air flow from the baffle plate drilled with some ten nozzles and made it collide against a hollow-cone shape fuel spray. In the direct injection type diesel, the L/D (where L and D are length and diameter, respectively of the nozzle) influences the spray characteristics, and changes the fuel cost and total hydrocarbons contained in the exhaust gas. Particulates in the exhaust gas quantitatively reduced with heightening in injection pressure. The heightening of injection velocity above that in the turbulent flow region generally forms a spray region the surrounding portion of which is immediately atomized by touching the air. However, liquid inside the spray remains forming a liquid column which is vibrating. The length of that column shortens proportionally to the injection velocity. However above a certain injection velocity, no longer split occurs in spite of heightening of velocity and the liquid column remains of a constant length in the central portion. For the combustion, it is difficult to exactly optimize the particulate size distribution of spray as influenced by many factors. 4 refs., 7 figs.

03 NATURAL GAS

0302 Reserves, Geology, and Exploration

Refer also to citation(s) 22776, 22777, 22785, 22786, 22787, 22788

22848 (CONF-9207203–, pp. 27-31) **Origin of natural gas.** Wakita, H. (The University of Tokyo, Tokyo (Japan). Faculty of Science). 22 Jul 1992. 320p. (In Japanese). From 1. meeting of The Japan Institute of Energy and the 70th Foundation anniversary meeting; Tokyo (Japan); 22-24 Jul 1992. In *Proceedings of the 1st Meeting of the Japan Institute of Energy and the 70th Foundation Anniversary Meeting.* Order Number DE93793523. Source: OSTI; NTIS (US Sales Only).

Introduction was made of natural gas originating in igneous activity (magmatism). Green tuff (GT) stratum originates in a large scale volcanic activity on the seabed about 15 million years ago and forms the Sea of Japan's seaboard of Tohoku District. Natural gas (GT gas) produced there remarkably differs in contained He isotopes from that which biologically originates and is produced on the Pacific seaboard. 15 million years ago, the present western half of Japan's north-eastern part was submerged on the shallow seabed and there existed a large Graben lengthening from north to south. Along the central axis of that Graben. violent volcanic activity on the seabed produced lava with surface fractures, through which seawater penetrated. The Graben was buried under volcanic clastics containing seawater which was left intact of a high temperature state so that magmatic gas was confined in the clastics by a hydrostatic pressure of 1000m in sea depth. With a continuation of GT action by the igneous activity, mutual action proceeded between the rock and seawater during the geological elapsing of time, which then produced GT rock stratum. In parallel with it, CO2 contained in the magmatic gas finally changed into methane, which was so stored in the GT stratum as to form a very large natural gas layer. 2 refs., 1 fig., 1 tab.

22849 (CONF-9207203–, pp. 32-35) **Deep gas.** Hoshino, K. (Shimizu Construction Co. Ltd., Tokyo (Japan)). 22 Jul 1992. 320p. (In Japanese). From 1. meeting of The Japan Institute of Energy and the 70th Foundation anniversary meeting; Tokyo (Japan); 22-24 Jul 1992. In *Proceedings of the 1st Meeting of the Japan Institute of Energy and the 70th Foundation Anniversary Meeting.* Order Number DE93793523. Source: OSTI; NTIS (US Sales Only).

Research was explained on non-conventional type natural gas which had become a conspicuous object of research with appearance of the theory that the natural gas originates in the inorganic methane. The natural gas (methane) which is being presently mined is mostly so-called oil-associated gas and founds the organic origination theory. However, entering the 1980's, attention was paid to the inorganic origination theory by Prof. Gold and Prof. Wakita. Intention which has recently become strong is to grasp the natural gas not only based on the inorganic gas hypothesis but also inclusively of natural gas existing or originating in the deep earth by investigating the actual conditions of geological deep earth structure and magmatic activity, and deep gas properties depending upon those conditions. For example, the deep gas is classified into abiogenic gas, subduction gas and deep sedimentary gas. Natural gas which is discussable both organically and inorganically was discovered in the deep earth of some of the existing gas fields in the US. In Europe, trace quantity of methane was discovered also in altered rock zones of the Precambrian Period. Research has started on the deep gas also in Japan. 13 refs.

22850 (CONF-9207203–, pp. 36-38) **Natural gas hydrate.** Okuda, Y. (Geological Survey of Japan, Tsukuba (Japan)). 22 Jul 1992. 320p. (In Japanese). From 1. meeting of The Japan Institute of Energy and the 70th Foundation anniversary meeting; Tokyo (Japan); 22-24 Jul 1992. In *Proceedings of the 1st Meeting of the Japan Institute of Energy and the 70th Foundation Anniversary*

Meeting. Order Number DE93793523. Source: OSTI; NTIS (US Sales Only).

Out of natural gas hydrates existing underground, methane hydride is described. This is a sherbet-ice-state clathrate consisting of molecules of methane and water. It is said that methane obtained from the depth originates from biological fermentation, and that from the shallow place originates from thermal decomposition. In the sections recorded in marine seismic prospecting in the marginal region of the continent, reflection surfaces of strong amplitude called BSR (bottom simulating reflector) are often seen in parallel to the sea bottom surface and correspond to the bottom surface of the stable region of methane hydrate. Distribution of resources is expected in most of continental slopes inside the Pacific trench, continental slopes in the Atlantic-continental rises, and sea areas around the Antarctic Continent. BSR lies around 100-1100m below the sea bottom and some of it is confirmed by deepsea drilling. In the land area, it exists only inside the permafrost in Siberia, Canada and Alaska. In Japan it is said that it exists in slopes inside Nankai trough, the sea area of the offing of Tokachi-the offing of Hidaka, the offing of Tsugaru, etc. The worldwide amount of resource is several tens of trillion m^3in the land and several thousands of trillion m^3 in the sea.

22851 (CONF-9207203–, pp. 39-42) **Development of gas fields in arctic region.** Saka, K. 22 Jul 1992. 320p. (In Japanese). From 1. meeting of The Japan Institute of Energy and the 70th Foundation anniversary meeting; Tokyo (Japan); 22-24 Jul 1992. In *Proceedings of the 1st Meeting of the Japan Institute of Energy and the 70th Foundation Anniversary Meeting.* Order Number DE93793523. Source: OSTI; NTIS (US Sales Only).

The paper describes exploration and development of oil and gas fields mainly in th arctic region. The region is under severe conditions such s ultra-low temperature down to -50°C, storm, sea ice, permafrost reaching down to several hundreds of meters underground and is very far from the existing infrastructure. Special specifications for the polar region are used for quality of materials and machinery. For safety, working facilities are as well as survival systems are perfectly shut out from outside, thermally insulated, and air-heated. For most of the pipelines and flow lines, freezing-prevention measures are taken such as thermally insulation and displacement of inert gas. Since the permafrost loses its bearing power of soil when it melts, the sites and roads are thermally insulated by gravel pads, and production modules are separated from the ground and installed on vertical support members. Drilling easing is designed to stand fracture loads using heat insulating materials and cushioning materials in order to prevent freezing fracture. Necessary facilities are separated in module for transportation, installation and assembly at sites which are very far. 1 fig., 1 tab.

22852 (DOE/MC/20422–3319) **Well log evaluation of natural gas hydrates.** Collett, T.S. Geological Survey, Denver, CO (United States). Oct 1992. 52p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AI21-83MC20422. Order Number DE93000255. Source: OSTI; NTIS; GPO Dep.

Gas hydrates are crystalline substances composed of water and gas, in which a solid-water-lattice accommodates gas molecules in a cage-like structure. Gas hydrates are globally widespread in permafrost regions and beneath the sea in sediment of outer continental margins. While methane, propane, and other gases can be included in the clathrate structure, methane hydrates appear to be the most common in nature. The amount of methane sequestered in gas hydrates is probably enormous, but estimates are speculative and range over three orders of magnitude from about 100,000 to 270,000,000 trillion cubic feet. The amount of gas in the hydrate reservoirs of the world greedy exceeds the volume of known conventional gas reserves. Gas hydrates also represent a significant drilling and production hazard. A fundamental question linking gas hydrate resource and hazard issues is: What is the volume of gas hydrates and included gas within a given gas hydrate occurrence? Most published gas hydrate resource estimates have, of necessity, been made by broad extrapolation of only general knowledge of local geologic conditions. Gas volumes that may be attributed to gas hydrates are dependent on a number of reservoir parameters, including the areal extent ofthe gas-hydrate occurrence, reservoir thickness, hydrate number, reservoir porosity, and the degree of gas-hydrate saturation. Two of the most difficult reservoir parameters to determine are porosity and degreeof gas hydrate saturation. Well logs often serve as a source of porosity and hydrocarbon saturation data; however, well-log calculations within gas-hydrate-bearing intervals are subject to error. The primary reason for this difficulty is the lack of quantitative laboratory and field studies. The primary purpose of this paper is to review the response of well logs to the presence of gas hydrates.

0303 Drilling, Production, and Processing

Refer also to citation(s) 22776, 22777, 22829, 22846, 22851, 24269

22853 (ETDE/JP-mf–93794512, pp. 240-242) **Well stimulation technology.: Field experiment of massive hydraulic fracturing.** Sugiyama, H.; Nanba, T.; Onoe, S. Japan National Oil Corp., Tokyo (Japan). 30 Oct 1992. 537p. (In Japanese). In *Record of TRC's activities in the fiscal year 1991.* Order Number DE93794512. Source: OSTI; NTIS (US Sales Only).

A field test was performed on a hydraulic fracturing method applied to reservoir rocks comprising multi-lithofacies at great depths, as part of the special research program, 'well stimulation technology' at the Technology Development Center of Japan National Oil Corporation, which aims at establishing an integrated technology. This paper is a 1991 annual report describing evaluations on well capacity changes and fracture shapes after the fracturing (MHF) was carried out in the previous fiscal year at the Nagaoka gas field. As a result of conducting a three-point isochronal test in July 1991, nearly one year after the MHF implementation, and comparing the result with the test in the previous fiscal year, the well capacity was judged to have changed very little. With an objective of evaluating the fracture shapes, a long-term flow test was conducted after the above test, with a flow for 12 days and a shut-in for 40 days. As a result, the fracture length was inferred to be as short as 10 m as in the test immediately after the MHF. A second well for a verification test was selected from among the suspended wells. 3 figs.

22854 (ETDE/JP-mf–93794512, pp. 248-252) **Well stimulation technology.: Hydraulic fracturing for coal bed methane.** Onoe, S.; Sugiyama, H. Japan National Oil Corp., Tokyo (Japan). 30 Oct 1992. 537p. (In Japanese). In *Record of TRC's activities in the fiscal year 1991.* Order Number DE93794512. Source: OSTI; NTIS (US Sales Only).

Results of hydraulic fracturing in coal bed gas developing wells were discussed as part of the research program, 'well stimulation technology' at the Technology Development Center of Japan National Oil Corporation, which aims at establishing a hydraulic fracturing technology for naturally fractured reservoirs. This paper is a 1991 annual report describing the discussions which have been given while carrying out hydraulic fracturing tests at the Nagaoka gas field since 1988. An investigation work was commissioned in fiscal 1991 to Gaffney, Cline and Associates in the U.S.A. on the 'current status of coal bed methane gas development'. The investigation has provided a large number of useful information when referred to abnormal pressure phenomena that have been experienced in the previous tests. The information included investigations on patterns of abnormal behavior in hydraulic fracturing of coal beds and post-drilling of hydraulically fractured coal beds, and proposals on fracture designs. Studies on technology improvement will be moved forward based on these investigation results. In addition, it would be necessary to develop a simulator that can perform quantitative evaluation, for example. 2 figs.

0304 Products and By-Products

Refer also to citation(s) 23883

22855 (CONF-9207203–, pp. 47-50) **Selective oxidative coupling of methane by using membrane reactor.** Nozaki, T. (The University of Tokyo, Tokyo (Japan). Faculty of Engineering); Yamazaki, O.; Omata, K.; Fujimoto, K. 22 Jul 1992. 320p. (In Japanese). From 1. meeting of The Japan Institute of Energy and the 70th Foundation anniversary meeting; Tokyo (Japan); 22-24 Jul 1992. In *Proceedings of the 1st Meeting of the Japan Institute of*

Energy and the 70th Foundation Anniversary Meeting. Order Number DE93793523. Source: OSTI; NTIS (US Sales Only).

Methane which is the main content of natural gas was taken up as base material. Study was done of a C2 hydrocarbon synthesis by supplying oxygen to it with the use of thin lead oxide membrane reactor. Lead oxide working effectively for the selective oxidative coupling reaction, lattice oxygen oxidatively dehydrogenates the methane and produces methyl radicals, which then produce C2 hydrocarbon through their bonding among themselves. Simultaneously supplied oxygen, though necessary for the reoxidation of methane-reduced lead, by-produces COx through oxidizing even the methyl radicals. A membrane reaction system was proposed to avoid it. An outer methane passage tube of porous support was slurry-coated with lead oxide catalyst film and sintered. Lattice oxygen is supplied by having oxygen pass inside the film and diffusing it by oxygen ion concentration gradient into the outer methane passage tube, which supply prevents COx from being by-produced by the passing oxygen and heightens the selectivity of reaction. The reaction speed could be expressed by a membrane reaction model which took both the reaction speed on surface and moving rate of oxygen inside film into consideration so that the membrane reaction system could be demonstrated in mechanism. 4 refs., 5 figs.

22856 (CONF-9207203–, pp. 51-54) **Development of low-temperature distillation process of methane.** Kurahashi, K. (Tokyo Gas Co. Ltd., Tokyo (Japan)); Nishiguchi, Y.; Haga, K. 22 Jul 1992. 320p. (In Japanese). From 1. meeting of The Japan Institute of Energy and the 70th Foundation anniversary meeting; Tokyo (Japan); 22-24 Jul 1992. In *Proceedings of the 1st Meeting of the Japan Institute of Energy and the 70th Foundation Anniversary Meeting.* Order Number DE93793523. Source: OSTI; NTIS (US Sales Only).

Research was explained on the low temperature precision distillation/fraction of $^{13}CH4$ for the diversified utilization of LNG. The frequency of electromagnetic wave which has nuclear magnetic resonance occur is almost determined by the nuclear species and intensity of external magnetic field, and however, generates a minute gap (chemical shift) which reflects the value of electronic density around the atomic nucleus. The structure of organic compound and metabolism of biological tissue can be analyzed by using the chemical shift of ^{13}C-marked compound. Low cost ^{13}C is expected to be stably supplied. Diamond the raw material of which is ^{12}C is even 1.6 times as high as usual in thermal conductivity and gives an expectation of being applied to the semiconductor and laser. In the distillation/fraction and enrichment of ^{13}C, the theoretically necessary number of stages is large because of lowness in relative volatility (α). Pressure-reducing distillation was selected because of utilizing the fact that the α enlarges with lowering in temperature. By the pilot plant from raw methane of 500Nl/h, production was made of 95.0% concentricity $^{13}CH4$ of 0.4Nl/h and 99.9% concentricity $^{12}CH4$ of 5Nl/h with a possible recovery of residue as high purity methane.

22857 (DOE/PC/92111–T2) **Conversion of light hydrocarbon gases to metal carbides for production of liquid fuels and chemicals: Quarterly technical status report, January 1–March 31, 1993.** Diaz, A.F.; Modestino, A.J.; Howard, J.B.; Peters, W.A. Massachusetts Inst. of Tech., Cambridge, MA (United States). Apr 1993. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-92PC92111. (FE-MIT–92111-2). Order Number DE93014962. Source: OSTI; NTIS; GPO Dep.

Work on this project will be performed according to two tasks: Task 1, Industrial Chemistry and Applied Kinetics of Light Hydrocarbon Gas Conversion to Metal Carbides H_2 and CO. We are building a laboratory-scale electric are discharge reactor, in which to assess the technical feasibility of producing Mg_2C_3, H_2, and CO from methane and MgO. We will also do experimental runs with CaO as well as mixtures of CaO and MgO and measure conversions of methane, CaO and/or MgO, and yields of Mg_2C_3, and/or CaC_2, H_2, and CO to identify the operating conditions of interest for implementing these reactions on a commercial scale. Reaction conditions and parameters will be chosen based on the previous work at MIT with CaO and CH, and on results of thermodynamic and thermochemical kinetics calculations. Task 2: Mechanistic Foundations-For Convertings Light Hydrocarbon Gases to Metal Carbides-H_2 and CO. We will evaluate the technical feasibility of carrying out methane reactions with CaO and MgO by thermal (e.g. 1500–2000°C) rather than under plasma conditions by performing experiments with the use of electrical screen heaters, heated tubular reactors, or other suitable apparatus. Extents and global rates of methane conversion, and yields as well as global production rates of CaC_2, Mg_2C_3, H_2 and CO will be measured upon subjecting mixtures of methane and CaO and/or MgO to high temperatures and controlled residence times. We will conduct hypothesis-testing of possible mechanistic pathways with selected experiments and perform reaction modeling to better understand the underlying chemical and physical processes that could influence process scale-up possibilities.

22858 (ETDE/JP-mf–93794512, pp. 437-448) **Direct conversion of natural gas to liquid fuel.** Suzuki, N.; Takehira, S.; Tada, Y.; Tezuka, N. Japan National Oil Corp., Tokyo (Japan). 30 Oct 1992. 537p. (In Japanese). In *Record of TRC's activities in the fiscal year 1991.* Order Number DE93794512. Source: OSTI; NTIS (US Sales Only).

A number of natural gas accumulating structures have been discovered recently in the southeastern Asia. In order to promote effective utilization of natural gas produced in such remote areas, developmental researches have been carried out since 1990 on processes to synthesize the major component of the gas, methane, into liquid fuel such as gasoline through direction conversion and polymerization processes. This paper is a report on the results obtained during the fiscal 1993. Based on the results achieved by the previous year, developments have been made on new catalysts for direct conversion and polymerization reactions utilizing methane's oxidation coupling reaction, and materials that can withstand high temperatures and corrosion under high-temperature oxidizing conditions in the oxidation coupling reaction. Among other results including discussion on high-temperature catalysts for a direct reaction of C1 → C2, for example, several types of natural calcium based catalysts including coral sand were found to have performance to satisfy the target. The result of a life test, however, showed that the catalysts have a time-based activity decreasing trend that should have been caused from sintering due to generated steam. 2 refs., 7 figs., 2 tabs.

0305 Health and Safety

Refer also to citation(s) 23517

0306 Economic, Industrial, and Business Aspects

Refer also to citation(s) 22831, 22836, 22837, 22842, 23786

0307 Waste Management

Refer also to citation(s) 22838, 22839, 22840

0308 Environmental Aspects

Refer also to citation(s) 22842, 22843, 22844

0320 Transport, Handling, and Storage

Refer also to citation(s) 22846

22859 (SAND–92-2545) **Effects of cavern spacing on the performance and stability of gas-filled storage caverns.** Hoffman, E.L. Sandia National Labs., Albuquerque, NM (United States). Apr 1993. 32p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. Order Number DE93013497. Source: OSTI; NTIS; GPO Dep.

Three-dimensional finite element analyses of gas-filled storage caverns in domal salt were performed to investigate the effects of cavern spacing on surface subsidence, storage loss, and cavern stability. The finite element model used for this study models a seven cavern storage field with one center cavern and six hexagonally spaced surrounding caverns. Cavern spacing is described in

terms of the P/D ratio which is the pillar thickness (the width between two caverns) divided by the cavern diameter. With the stratigraphy and cavern size held constant, simulations were performed for P/D ratios of 6.0, 3.0, 2.0, 1.0, and 0.5. Ten year simulations were performed modeling a constant 400 psi gas pressure applied to the cavern lining. The calculations were performed using JAC3D, a three dimensional finite element analysis code for nonlinear quasistatic solids. For the range of P/D ratios studied, cavern deformation and storage volume were relatively insensitive to P/D ratio, while subsidence volume increased with increasing P/D ratio. A stability criterion which describes stability in terms of a limiting creep strain was used to investigate cavern stability. The stability criterion indicated that through-pillar instability was possible for the cases of P/D = 0.5 and 1.0.

0330 Properties and Composition

Refer also to citation(s) 22856

0340 Combustion

Refer also to citation(s) 22764, 23786, 23807, 23877, 24627

04 OIL SHALES AND TAR SANDS

Refer also to citation(s) 23795

0404 Oil Production, Recovery, and Refining

Refer also to citation(s) 22863

22860 (DOE/MC/11089–3318) **Pressurized fluidized-bed hydroretorting of Eastern oil shales: Annual report, June 1991–May 1992.** Roberts, M.J. (Institute of Gas Technology, Chicago, IL (United States)); Mensinger, M.C.; Rue, D.M.; Lau, F.S.; Schultz, C.W.; Parekh, B.K.; Misra, M.; Bonner, W.P. Institute of Gas Technology, Chicago, IL (United States). Nov 1992. 356p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC21-87MC11089. Order Number DE93000254. Source: OSTI; NTIS; GPO Dep.

The Devonian oil shales of the Eastern United States are a significant domestic energy resource. The overall objective of the multi-year program, initiated in October 1987 by the US Department of Energy is to perform the research necessary to develop the Pressurized Fluidized-Bed Hydroretorting (PFH) process for producing oil from Eastern oil shales. The program also incorporates research on technologies in areas such as raw shale preparation, beneficiation, product separation, and waste disposal that have the potential of improving the economics and/or environmental acceptability of recovering oil from oil shales using the PFH process. The results of the original 3-year program, which was concluded in May 1991, have been summarized in a four-volume final report published by IGT. DOE subsequently approved a 1-year extension to the program to further develop the PFH process specifically for application to beneficiated shale as feedstock. Studies have shown that beneficiated shale is the preferred feedstock for pressurized hydroretorting. The program extension is divided into the following active tasks. Task 3. testing of process improvement concepts; Task 4. beneficiation research; Task 5. operation of PFH on beneficiated shale; Task 6. environmental data and mitigation analyses; Task 7. sample procurement, preparation, and characterization; and Task 8. project management and reporting. In order to accomplish all the program objectives, the Institute of Gas Technology (IGT), the prime contractor, worked with four other institutions: the University of Alabama/Mineral Resources Institute (MRI), the University of Kentucky Center for Applied Energy Research (UK-CAER), the University of Nevada (UN) at Reno, and Tennessee Technological University (TTU). This report presents the work performed during the program extension from June 1, 1991 through May 31, 1992.

0406 Products and By-Products

Refer also to citation(s) 22666, 22668

0408 Economic, Industrial, and Business Aspects

22861 (DOE/MC/25045–3342) **Economic assessment of government-managed tar sand deposits in Utah: Final report.** Bunger, J.W. (Utah Univ., Salt Lake City, UT (United States)); Berry, C.W.; Devineni, P.A.V.; Deng, R. Department of the Interior, Washington, DC (United States); Utah Univ., Salt Lake City, UT (United States). Sep 1992. 65p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AI21-88MC25045. Order Number DE93000279. Source: OSTI; NTIS; INIS; GPO Dep.

In 1989 the US Department of the Interior asked the University of Utah to evaluate the economic potential of tar sand resources located in Utah. Particular emphasis was to be placed on tar sand resources located on Federal land. The primary purpose of this study was to provide the Federal government with information useful in developing policy, development programs, and in facilitating land management issues. Because these resources are valuable energy properties, many of which are owned by the Federal and State governments, development of these resources will not only contribute to domestic energy supplies but will provide revenues to the government. This study defines those areas in which impediments exist for development. Impediments may relate to physical characteristics of the deposit, state of technology development, product value, and markets. Impediments also may relate to institutional factors including legal, regulatory, and policy matters. Collectively, lack of critical information increases the investment risk factor. Investments are inhibited if there is a lack of definitive information in one or more critical areas. This study defines those areas of economic importance and a framework is established to help define remaining research and development requirements. Economic analysis has resulted in specific conclusions regarding the utilization of various deposits.

0409 Waste Management

22862 (UCRL-JC–110320-Pt.1) **Catalytic activity of oxidized (combusted) oil shale for removal of nitrogen oxides with ammonia as a reductant in combustion gas streams, Part 1.** Reynolds, J.G.; Taylor, R.W.; Morris, C.J. Lawrence Livermore National Lab., CA (United States). 10 Jun 1992. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-920815–22-Pt.1: 204. American Chemical Society (ACS) national meeting, Washington, DC (United States), 23-28 Aug 1992). Order Number DE93012587. Source: OSTI; NTIS; GPO Dep.

Oxidized oil shale from the combustor in the LLNL hot recycle solids oil shale retorting process has been studied as a catalyst for removing nitrogen oxides from laboratory gas streams using NH_3 as areductant. Combusted Green River oil shale heated at 10°C/min in an $Ar/O_2/NO/NH_3$ mixture (~93%/6%/2000 ppm/4000 ppm) with a gas residence time of ~0.6 sec exhibited NO removal between 250 and 500°C, with maximum removal of 70% at ~400°C. Under isothermal conditions with the same gas mixture, the maximum NO removal was found to be ~64%. When CO_2 was added to the gas mixture at ~8%, the NO removal dropped to ~50%. However, increasing the gas residence time to ~1.2 sec, increased NO removal to 63%. These results are not based on optimized process conditions, but indicate oxidized (combusted) oil shale is an effective catalyst for NO removal from combustion gas streams using NH_3 as the reductant.

0440 Combustion

22863 (DOE/MC/27401–3332) **A feasibility study of oil shale fired pulse combustors with applications to oil shale retorting: Final report.** Morris, G.J.; Johnson, E.K.; Zhang, G.Q.; Roach, R.A. West Virginia Univ., Morgantown, WV (United States). Dept. of Mechanical and Aerospace Engineering. Jul 1992. 34p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG21-90MC27401. Order Number DE93000269. Source: OSTI; NTIS; GPO Dep.

The results of the experimental investigation performed to determine the feasibility of using pulverized Colorado oil shale to fuel a bench scale pulse combustor reveal that oil shale cannot sustain

pulsations when used alone as fuel. Trace amounts of propane mixed with the oil shale enabled the pulsations, however. Up to 80% of the organic material in the oil shale was consumed when it was mixed with propane in the combustor. Beyond the feasibility objectives, the operating conditions of the combustor fuel with propane and mixtures of oil shale and propane were characterized with respect to pulsation amplitude and frequency and the internal combustor wall temperature over fuel lean and fuel rich stoichiometries. Maximum pressure excursions of 12.5 kPa were experienced in the combustor. Pulsation frequencies ranged from 50 to nearly 80 Hz. Cycle resolved laser Doppler anemometry velocities were measured at the tail pipe exit plane. Injecting inert mineral matter (limestone) into the pulse combustor while using propane fuel had only a slight effect on the pulsation frequency for the feed rates tested.

05 NUCLEAR FUELS

Refer also to citation(s) 24078, 24079

0501 Reserves, Exploration, and Mining

Refer also to citation(s) 24980

22864 (INIS-mf–13518, pp. E12) **Some economy problems associated with keeping down the uranium mining by leaching in the Straz block.** Novak, J. (DIAMO, Straz pod Ralskem (Czechoslovakia)); Vladyka, P. 1992. [76p.] (In Czech). (CONF-9210351–: The mining town of Pribram in science and technology, Pribram (Czechoslovakia), 12-14 Oct 1992). In *The mining town of Pribram in science and technology. Abstracts of contributions.* Order Number DE93625342. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. SOLUTION MINING/economic analysis; LAND RECLAMATION; URANIUM MINES

22865 (JAERI-M–93-023) **Natural analogue studies: Mineral alteration and uranium migration.** Murakami, Takashi (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Tokai Research Establishment). Japan Atomic Energy Research Inst., Tokyo (Japan). Feb 1993. 25p. (In Japanese). Order Number DE93797600. Source: OSTI; NTIS; INIS.

The Alligator Rivers Analogue Project, an international project, was carried out from 1987 to 1992 using the Koongarra uranium ore deposit in northern Australia as a site. This report reviews the papers, published during that period, concerning 'mineral alteration and uranium migration'. The analyses of rocks and model calculations established that the uranium migration has been affected by the mineral alteration. (author).

0504 Feed Processing

22866 (INIS-mf–13518, pp. Z15) **Critical conditions of managing the MAPE mill tailings ground in relation to land reclamation.** Novotny, J. (Interprojekt Praha (Czechoslovakia)). 1992. [76p.] (In Czech). (CONF-9210351–: The mining town of Pribram in science and technology, Pribram (Czechoslovakia), 12-14 Oct 1992). In *The mining town of Pribram in science and technology. Abstracts of contributions.* Order Number DE93625342. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. TAILINGS/land reclamation; GEOLOGIC STRUCTURES; ORE PROCESSING; REVEGETATION; TAILINGS; URANIUM ORES

0505 Uranium Enrichment

Refer also to citation(s) 23092, 23134, 23956

22867 (POEF-T–3545) **Calculating atomic number densities for uranium compounds.** Taylor, R.W. Jr. (Battelle, Columbus, OH (United States)); Davis, T.C.; Newvahner, R.L. Portsmouth Gaseous Diffusion Plant, OH (United States). Jan 1993. 176p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-76OR00001. Order Number DE93008985. Source: OSTI; NTIS; INIS; GPO Dep.

This report presents a set of standardized methods for calculating the densities of selected mixtures of uranium compounds and moderating materials. The mixtures specifically analyzed are: UO_2 and water, U_3O_8 and water, UF_6 and HF, and UO_2F_2 and water. The densities of the various isotopes (especially hydrogen and U-235) in such mixtures are important input parameters in nuclear criticality safety analyses. The use of a standardized set of methods for calculating the densities will promote consistency and comparability in criticality safety calculations. The equations used to determine the densities for the various mixtures of interest have been incorporated into a computer program to facilitate calculations. The computer program, NUMDEN, is written in FORTRAN and can calculate mixture densities, densities of each element, atomic number densities of each element and uranium isotope, the weight fractions of each element, and determine which of the resonance corrected cross sections for U-235 and U-238 from the 16-group Hansen Roach set should be used. Standard FORTRAN is used to allow the code to be compiled on a wide variety of platforms. The program can write output files that are compatible with KENO Va, KENO IV, or KENO PC.

22868 (UCRL-ID–113745) **Issues and recommendations related to replacement of CFC-114 at the uranium enrichment gaseous diffusion plant: Task title: Chlorofluorocarbon (CFC) Program Review, Final report, August 1, 1991–October 1, 1992.** Anderson, B.L.; Banaghan, E. Lawrence Livermore National Lab., CA (United States). 31 Mar 1993. 31p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE93014681. Source: OSTI; NTIS; INIS; GPO Dep.

The operating uranium enrichment gaseous diffusion plants (GDPs) in Portsmouth, Ohio and Paducah, Kentucky, which are operated for the United States Department for Energy by Martin Marietta Energy Systems (MMES), currently use a chlorofluorocarbon (CFC-114) as the primary process stream coolant. Due to recent legislation embodied in the Clean Air Act, the production of this and other related chlorofluorocarbons (CFCS) are to be phased out with no production occurring after 1995. Since the plants lose approximately 500,000 pounds per year of this process stream coolant through various leaks, the GDPs are faced with the challenge of identifying a replacement coolant that will allow continued operation of the plants. MMES formed the CFC Task Team to identify and solve the various problems associated with identifying and implementing a replacement coolant. This report includes a review of the work performed by the CFC Task Team, and recommendations that were formulated based on this review and upon original work. The topics covered include; identifying a replacement coolant, coolant leak detection and repair efforts, coolant safety concerns, coolant level sensors, regulatory issues, and an analytical decision analysis.

22869 (UCRL-LR–111984-93-1, pp. 1-3) **U-AVLIS program overview.** Lawrence Livermore National Lab., CA (United States). 1992. In *Isotope separation and advanced manufacturing technology: Semiannual report, April-September 1992, Volume 1, No. 1.* 32p. Order Number DE93006256. Source: OSTI; NTIS (US Sales Only).

The Uranium Enrichment Enterprise of the US Department of Energy (DOE) is vital to the fuel supply of nuclear power plants in the US and abroad. From the inception of the Uranium Atomic Vapor Laser Isotope Separation (U-AVLIS) Program, its purpose has been to provide the US with an enrichment technology that produces nuclear fuel at a lower cost than the current technologies - gaseous diffusion and gas centrifuge. The US role in the international uranium enrichment market has historically been important to this country for reasons of energy security, national security, technological leadership, economic competitiveness, balance of trade, safeguards and nonproliferation policies, and employment. Deployment of U-AVLIS can help us to achieve our policy objectives in these significant areas. Evolving market, economic, and technological forces all point to this country's need for a new, low-cost, environmentally clean uranium enrichment capability. An assessment of foreign competition, enrichment market demand, and the aging equipment in our existing gaseous diffusion plants indicates

that the US Uranium Enrichment Enterprise is likely to become increasingly less competitive beyond the mid-1990s. The overall objectives of the AVLIS Program are to develop, demonstrate, and document a uranium enrichment process capable of maintaining a competitive US Uranium Enrichment Enterprise in the long-term.

22870 (UCRL-LR–111984-93-1, pp. 4-9) **Production plant laser system conceptual design.** Lawrence Livermore National Lab., CA (United States). 1992. In *Isotope separation and advanced manufacturing technology: Semiannual report, April-September 1992, Volume 1, No. 1.* 32p. Order Number DE93006256. Source: OSTI; NTIS (US Sales Only).

A full conceptual design of a U-AVLIS production plant capable of producing ~1700 metric tons of enriched uranium per year has been accomplished as a first step in the deployment of AVLIS enrichment technology. This article describes the design of the plant laser system which is characterized by the work breakdown structure (WBS). The other major systems in the U-AVLIS production plant will be described in subsequent issues. The principal elements of the laser system for the U-AVLIS production plant are the copper laser system, tunable laser systems, beam transport systems, separator optical systems, and the laser buildings. The primary interfaces of the laser system are to the separator system and the control systems.

22871 (UCRL-LR–111984-93-1, pp. 10-15) **Beam quality improvements in copper vapor laser oscillators.** Lawrence Livermore National Lab., CA (United States). 1992. In *Isotope separation and advanced manufacturing technology: Semiannual report, April-September 1992, Volume 1, No. 1.* 32p. Order Number DE93006256. Source: OSTI; NTIS (US Sales Only).

The use of copper lasers in uranium isotope separation and other applications such as precision material processing would benefit from a near-diffraction-limited output beam. The simplest technique to improve the beam quality from high-gain and high-Fresnel-number laser media such as copper is to use a high-magnification unstable resonator. However, in such an oscillator cavity, only the latter part of the output pulse can reach the near-diffraction limit since only a small number of cavity round trips (typically 3 or 4) can be established during the 50- to 70-ns optical pulse. High-magnification unstable cavities also result in lower output powers and severe pulse temporal modulation, which are undesirable effects. In order to obtain a low beam-divergence output for the entire duration of the output pulse without significant power reduction, an injection-seeding configuration was implemented for the copper lasers in the Laser Demonstration Facility (LDF). In this configuration, the output of an unstable-resonator master oscillator (MO) with a magnification of M~15 is injected into a second unstable-resonator injection-locked oscillator (ILO) which also has a magnification of M~15. This particular injection scheme still has several shortcomings, however. It produces an ILO output beam with dual output modes; a beam divergence which is still far from diffraction limited (10-15 XDL), and undesired parasitic oscillation which results from intense injection feedback to the MO. An improved MO/ILO cavity and injection design is needed to resolve these issues. A parametric study was therefore done to analyze the effect of different cavity designs and alternate injection schemes on ILO output beam quality and power.

22872 (UCRL-LR–111984-93-1, pp. 16-20) **High-average power copper-pumped dye lasers.** Lawrence Livermore National Lab., CA (United States). 1992. In *Isotope separation and advanced manufacturing technology: Semiannual report, April-September 1992, Volume 1, No. 1.* 32p. Order Number DE93006256. Source: OSTI; NTIS (US Sales Only).

For several years, the AVLIS Program has been developing a kilowatt-class tunable laser system for isotopic separation of uranium. In order to produce an economically viable photoionization process, system considerations indicate the requirement for kilohertz-pulse repetition rates, near-diffraction-limited beam quality, accurate spectral control, and stable, long-term operation. The AVLIS dye laser system, the world's highest-average power, visible, tunable laser system, demonstrates all of these characteristics simultaneously.

22873 (UCRL-LR–111984-93-1, pp. 21-32) **Measurements of the thermal radiative properties of liquid uranium.** Havstad, M.A.; McLean, W. II; Self, S.A. Lawrence Livermore National Lab., CA (United States). 1992. In *Isotope separation and advanced manufacturing technology: Semiannual report, April-September 1992, Volume 1, No. 1.* 32p. Order Number DE93006256. Source: OSTI; NTIS (US Sales Only).

The thermal radiative properties of the surfaces of various metals at high temperature, both below and above the melting point, are important to a wide range of research and development activities, including laser isotope separation, laser welding, metal refining, electron-beam processing, and vacuum-arc remelting. These properties, namely the reflectivity, absorptivity, and emissivity, influence the energy balance and heat transfer in such applications and thereby determine performance and economic viability. Thermal radiative properties are often vital input data for heat transfer computations performed during development of a process. The accuracy of the input data determines the results of calculations that provide the understanding needed to make design changes and successfully complete development. The properties of uranium in particular have only rarely been measured, and then only over limited parameter ranges. Accurate information is required on the three surface radiative properties as a function of wavelength, temperature, and angle relative to the surface normal over an appropriately wide range of the latter three parameters. Studies of liquid metals are relatively rare. A review of the reported work in this area indicates a large scatter in the data and general lack of agreement between results of various workers. These discrepancies are probably caused by the difficulties in performing measurements on liquid metal surfaces, which are sufficiently free of impurities. Ultrahigh vacuum (UHV) conditions ~10^{-9} Torr are necessary because liquid metal surfaces are highly reactive.

0507 Fuels Production and Properties

Refer also to citation(s) 22943, 23130, 23489, 23490, 23602

22874 (DPW–53-3-8) **[Minutes of meeting of Atomic Energy Division, Engineering Department, Explosives Department].** List, J.A. Du Pont de Nemours (E.I.) and Co., Wilmington, DE (United States). 15 May 1953. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. (SR/H–517). Order Number DE93012045. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report dated May 15, 1953 details the following aspects concerning construction of the Explosives Department at the Savannah River Plant: cylinder loading facilities; heat exchangers;and condensate separators.

22875 (DPW–53-3-10) **[Minutes of meeting of Atomic Energy Division, Engineering Department, Explosives Department].** List, J.A. Du Pont de Nemours (E.I.) and Co., Wilmington, DE (United States). 19 Jun 1953. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. (SR/H–518). Order Number DE93012046. Source: OSTI; NTIS (US Sales Only); GPO Dep.

A meeting on June 19, 1953 was devoted to a discussion of the Savannah River power contract and the questions the AEC have raised recently regarding it. This report document discussion that took place at this meeting.

0508 Spent Fuels Reprocessing

Refer also to citation(s) 22891, 23091, 23488, 24013, 24120, 24908

22876 (ANL/FC/CP–76768) **Integral Fast Reactor fuel pin processor.** Levinskas, D. Argonne National Lab., Idaho Falls, ID (United States). [1993]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-930403–47: 5. topical meeting on robotics and remote systems, Knoxville, TN (United States), 26-29 Apr 1993). Order Number DE93009957. Source: OSTI; NTIS; INIS; GPO Dep.

This report discusses the pin processor which receives metal alloy pins cast from recycled Integral Fast Reactor (IFR) fuel and prepares them for assembly into new IFR fuel elements. Either full

length as-cast or precut pins are fed to the machine from a magazine, cut if necessary, and measured for length, weight, diameter and deviation from straightness. Accepted pins are loaded into cladding jackets located in a magazine, while rejects and cutting scraps are separated into trays. The magazines, trays, and the individual modules that perform the different machine functions are assembled and removed using remote manipulators and master-slaves.

22877 (ANL/FC/CP–76869) **Advanced control system for the Integral Fast Reactor fuel pin processor.** Lau, L.D.; Randall, P.F.; Benedict, R.W.; Levinskas, D. Argonne National Lab., Idaho Falls, ID (United States). [1993]. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-930403–45: 5. topical meeting on robotics and remote systems, Knoxville, TN (United States), 26-29 Apr 1993). Order Number DE93009976. Source: OSTI; NTIS; INIS; GPO Dep.

A computerized control system has been developed for the remotely-operated fuel pin processor used in the Integral Fast Reactor Program, Fuel Cycle Facility (FCF). The pin processor remotely shears cast EBR- reactor fuel pins to length, inspects them for diameter, straightness, length, and weight, and then inserts acceptable pins into new sodium-loaded stainless-steel fuel element jackets. Two main components comprise the control system: (1) a programmable logic controller (PLC), together with various input/output modules and associated relay ladder-logic associated computer software. The PLC system controls the remote operation of the machine as directed by the OCS, and also monitors the machine operation to make operational data available to the OCS. The OCS allows operator control of the machine, provides nearly real-time viewing of the operational data, allows on-line changes of machine operational parameters, and records the collected data for each acceptable pin on a central data archiving computer. The two main components of the control system provide the operator with various levels of control ranging from manual operation to completely automatic operation by means of a graphic touch screen interface.

22878 (ANL/FC/CP–78468) **Simplified probabilistic risk assessment in fuel reprocessing.** Solbrig, C.W. Argonne National Lab., Idaho Falls, ID (United States). Fuel Cycle Div. [1993]. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-930404–13: International topical meeting on mathematical methods and supercomputing in nuclear applications (M&C+SNA '93), Karlsruhe (Germany), 19-23 Apr 1993). Order Number DE93009973. Source: OSTI; NTIS; INIS; GPO Dep.

An evaluation was made to determine if a backup mass tracking computer would significantly reduce the probability of criticality in the fuel reprocessing of the Integral Fast Reactor. Often tradeoff studies, such as this, must be made that would greatly benefit from a Probably Risk Assessment (PRA). The major benefits of a complete PRA can often be accrued with a Simplified Probabilistic Risk Assessment (SPRA). An SPRA was performed by selecting a representative fuel reprocessing operation (moving a piece of fuel) for analysis. It showed that the benefit of adding parallel computers was small compared to the benefit which could be obtained by adding parallelism to two computer input steps and two of the weighing operations. The probability of an incorrect material moves with the basic process is estimated to be 4 out of 100 moves. The actual values of the probability numbers are considered accurate to within an order of magnitude. The most useful result of developing the fault trees accrue from the ability to determine where significant improvements in the process can be made. By including the above mentioned parallelism, the error move rate can be reduced to 1 out of 1000.

22879 (CEA-CONF–11229) **Purex process improvements for the UP3 spent fuel reprocessing plant at La Hague, France.** Leudet, A. (CEA Centre d'Etudes de la Vallee du Rhone, 30 - Marcoule (France). Dept. des Procedes de Retraitement); Fournier, W.; Hugelmann, D.; Dalverny, G.; Bernard, C.; Miquel, P. CEA Centre d'Etudes de la Vallee du Rhone, 30 - Marcoule (France). Dept. des Procedes de Retraitement. 1990. [7p.] (CONF-9007123– : ISEC'90: international solvent extraction conference, Kyoto (Japan), 16-21 Jul 1990). Order Number DE93625344. Source: OSTI; NTIS (US Sales Only); INIS.

The UP3 reprocessing plant commissioned for active operation in November 1989 features numerous innovations both for the process flowsheet and the associated equipment. These innovations yielded positive results following initial active testing and are of considerable interest for solvent extraction specialists. This paper describes the main improvements introduced for the extraction cycles used to separate and purify uranium and plutonium. Specifically, these improvements include: adaptation of the first extraction cycle flowsheet for technetium decontamination and tritium confinement; solvent purification process based on distillation, a key element in the solvent system; flowsheets adapted for maximum recycling of liquid organic and mineral streams (solvent or nitric acid); use of annular or cylindrical pulsed columns with high-efficiency packing.

22880 (DOE/FTR–93013409) **Japanese chemical separations (partitioning) and transmutation activities: Foreign trip report, July 17–25, 1992.** Mellinger, G. Pacific Northwest Lab., Richland, WA (United States). 24 Aug 1992. 20p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93013409. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The primary focus of partitioning research and development in Japan is to separate the non-uranium elements in spent fuel into four groups: (1) transuranics (TRUs), (2) Sr and Cs, (3) Tc and platinum group metals, and (4) others. The Power Reactor and Nuclear Fuel Development Corporation (PNC) is pursuing improvements in the PUREX process to allow extraction of Np as well as U and Pu in a first PUREX extraction cycle. PNC is developing the TRUEX process to extract Am, Cm and any higher actinides present in the PUREX raffinate. Current plans call for separation of Am and Cm from the lanthanides by a TALSPEAK-type process. The Japan Atomic Energy Research Institute is evaluating solvent extraction processes that are alternatives to TRUEX and TALSPEAK. Mitsubishi is evaluating the use of crystallization techniques for separating U from dissolved spent fuel and the use of "insoluble tannin" for removal of U and TRUs from nitric acid solutions. PNC is developing an electrolytic deposition process to recover platinum group metals plus Ag and Tc from spent fuel dissolver solution. A molten lead extraction process is also being developed to recover these elements from spent fuel dissolver residue. Brief descriptions of visits to the Tokai Vitrification Facility, Joyo experimental fast breeder reactor,and Monju prototype LMFBR reactor are included in the report. The primary area of interest to the US was solvent extraction technology for separating TRUs and other radionuclides from high-level waste (HLW). Other potential areas of interest included noble metals separations and advanced sequestering agents for TRU removal from HLW. A recommendation will be made to the DOE that a plan be formulated and presented to PNC for information exchange in these areas.

22881 (DOE/ID–10423) **Recycling of nuclear spent fuel with AIROX processing.** Majumdar, D. (ed.) (USDOE Idaho Field Office, Idaho Falls, ID (United States)); Jahshan, S.N.; Allison, C.M.; Kuan, P.; Thomas, T.R. USDOE Idaho Field Office, Idaho Falls, ID (United States). Dec 1992. 67p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93012141. Source: OSTI; NTIS; INIS; GPO Dep.

This report examines the concept of recycling light water reactor (LWR) fuel through use of a dry-processing technique known as the AIROX (Atomics International Reduction Oxidation) process. In this concept, the volatiles and the cladding from spent LWR fuel are separated from the fuel by the AIROX process. The fuel is then reenriched and made into new fuel pins with new cladding. The feasibility of the concept is studied from a technical and high level waste minimization perspective.

22882 (DPW–3652) **Separations – denitration of UNH.** Evans, L.C. Du Pont de Nemours (E.I.) and Co., Wilmington, DE (United States). Atomic Energy Div. 30 Oct 1951. 2p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. (SR/H–520). Order Number DE93012048. Source: OSTI; NTIS (US Sales Only); GPO Dep.

In 1951 a program was initiated to determine the suitability of recovered Purex UNH for further processing. As of October 30, 1951 all of the test UNH has been denitrated to UO_3 at the Mallinckrodt Chemical Works (MCW) in St. Louis. A small portion of the UO_3 was retained at MCW and converted to UO_2 than to UF_4. This UF_4 was to be converted to metal in the near future. The remaining and major portion of the UO was to be processed immediately at K-25 and evaluated for the diffusion process.

22883 (HW–43332) **Summary analysis of the Redox Plant sand filter radiation measurements.** Slater, R. E. Hanford Atomic Products Operation, Richland, WA (United States). 26 Mar 1956. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93012368. Source: OSTI; NTIS (US Sales Only); GPO Dep.

"An Analysis of Redox Sand Filter Data," issued June 18, 1954, discussed increases in sand filter activity during the preceding six months, based upon air samples taken by Regional Radiation Measurement Unit of Radiological Sciences Department and upon vertical gamma radiation traverses (unshielded probe) made by the Redox Plant Radiation Monitoring Unit. "Estimated Activity in the Redox Sand Filter" dated July 15, 1954, were accurately defined the distribution of the activity within the sand filter by means of a radiation traverse with a partially shielded probe and by analyzing sand filter sand samples. Analysis of the shielded probe traverse data from the period following the last report through the most current data available reveals that the maximum radiation levels as measured by the shielded probe method were observed in July, 1954, and declined steadily, to an equilibrium, primarily from ruthenium decay.

22884 (INIS-mf–13503, pp. 215-220) **Total data management in the La Hague reprocessing plant.** Berthion, Y. (COGEMA/Etablissement de la Hague, Cherbourg (France)); Perot, J.P.; Silie, P. European Nuclear Society (ENS), Bern (Switzerland); Czech Nuclear Society, Prague (Czech Republic); Slovak Nuclear Society, Bratislava (Slovakia). Jan 1993. (CONF-921068–: East-West topical meeting: the safe and reliable operation of light water reactor NPP's, Prague (Czechoslovakia), 18-21 Oct 1992). In *Topform '92: the safe and reliable operation of LWR NPPs. Vol. II: Poster papers.* [245p.] Order Number DE93625345. Source: OSTI; NTIS (US Sales Only); INIS.

Due to the complexity of a spent fuel reprocessing plant and its nuclear characteristics, the operators must have real-time access to updated information on many subjects. To meet these requirements effectively, Cogema has installed a number of diversified data processing systems linked by a communications network called Haguenet. The whole system forms the La Hague Total Data Management System (TDMS) which performs a full range of functions, namely production data management, maintenance data management, technical documentation and miscellaneous. Some examples of the main process data management applications implemented within the La Hague TDMS are briefly described (nuclear materials and waste follow-up, analytical data management, operating procedures management and site inspection management). Also presented are some examples of the maintenance-related systems implemented within the La Hague TDMS (diagnostic assistance system, software maintenance center, maintenance interventions demand and spare parts data management). (Z.S.).

22885 (JAERI–1328) **Demonstration test on the safety of a cell ventilation system during a hypothetical explosive burning in a fuel reprocessing plant.** Suzuki, Motoe (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Tokai Research Establishment); Nishio, Gunji; Takada, Junichi; Tsukamoto, Michio; Koike, Tadao. Japan Atomic Energy Research Inst., Tokyo (Japan). Jan 1993. 104p. (In Japanese). Order Number DE93797595. Source: OSTI; NTIS; INIS.

To demonstrate the safety of an air ventilation system of cells in a fuel reprocessing plant under a postulated explosive burning caused by solvent fire or by thermal decomposition of nitrated solvent, four types of demonstration tests have been conducted using a large-scale facility simulating a cell ventilation system of an actual reprocessing plant, thus revealing effective mitigation by cell and duct structures on the pressure and temperature pulses generated by explosive burning. In boilover burning tests, solvent fire in a model cell was observed with various sizes of burning surface area as a main parameter, and analysis was performed on the factors dominating the magnitude of boilover burning, revealing that the magnitude strongly depends on accumulated amounts and their ratio of oxygen and solvent vapor present in the cell. In deflagration tests, solid rocket fuel was burned in the cell to simulate the explosive source. The generated pressure and temperature pulses were effectively declined by the cell and duct structures and the integrity of the ventilation system was kept. In blower tests, a centrifugal turbo blower was imposed by a lump of air with a larger flow rate than the rated one by about six times to observe the transient response of the blower fan and motor. It was found that integrity of the blower was kept. In pressure transient tests, compressed air was blown into the cell to induce a mild transient state of fluid dynamics inside the facility, and a variety of data were successfully obtained to be used for the verification and improvement of a computer code. In all the tests, transient overloading of gas caused no damage on HEPA filters, and overloading on the blower motor was avoided either by the slipping of transmission belt or by the acceleration of blower fan rotation during peak flow. (author).

22886 (JAERI-M–93-014) **Formation characteristics and its numerical models of the third phase in the U(IV)-HNO_3-TBP-n-dodecane system.** Ami, Norio (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Tokai Research Establishment); Suzuki, Shinichi; Abe, Hiroshi; Tachimori, Shoichi. Japan Atomic Energy Research Inst., Tokyo (Japan). Feb 1993. 48p. (In Japanese). Order Number DE93797584. Source: OSTI; NTIS; INIS.

Extraction experiments were carried out to study characteristics of the third phase formation in the 30 % TBP-n-dodecane-U(IV)-HNO_3 system. The third phase is formed by mixing 10 ml of aqueous solution and 10 ml of TBP-n-dodecane. Volumes and concentrations of U(IV) and HNO_3 of the aqueous, light organic and the third phases were measured after an equilibrium. Concentrations of TBP, n-dodecane and H_2O in two organic phases were also measured. The numerical equations which calculate the volume and the concentrations of U(IV) and HNO_3 not only for the third phase but also for the light organic phase were deduced by the regression analysis method as functions of concentrations of U(IV) and HNO_3 in the initial aqueous solution. The results of present study are as follows: 1) U(IV) concentration and volume of the third phase increased from 70 to 190 g/l and from 1.5 to 3.5 ml, respectively, with increasing in U(IV) concentration of the initial aqueous solution, from 40 to 130 g/l. 2) There were good correlation between U(IV) concentration of the initial aqueous solution and U(IV) concentration of the third phase, and between volume of the third phase and U(IV) concentration of the initial aqueous solution. 3) The TBP concentrations of the third phase (50 to 80 %) were correlated to U(IV) (40 to 130 g/l) and HNO_3 concentrations (1.5 to 6 mol/l) of the initial aqueous solution. 4) The concentrations of U(IV) and HNO_3 in the equilibrium aqueous phase were equal to the values calculated with an equation for distribution ratio without taking into account the third phase formation. (author).

22887 (JAERI-M–93-019) **Large-scale demonstration tests of solvent fire and boilover burning during the fire in fuel-reprocessing plant.** Nishio, Gunji (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Tokai Research Establishment); Suzuki, Motoe; Takada, Junichi; Koike, Tadao; Tukamoto, Michio. Japan Atomic Energy Research Inst., Tokyo (Japan). Feb 1993. 215p. (In Japanese). Order Number DE93797599. Source: OSTI; NTIS; INIS.

The demonstration test of solvent fire was performed in JAERI under auspices of the Science and Technology Agency to evaluate the safety of air-ventilation system in the event of hypothetical fire accident as DBA in a cell of the extraction process of the fuel-reprocessing plant of Japan. The demonstration test was carried out by focussing on fire behavior in the cell and HEPA filter plugging by smoke under a steady-state burning of solvent, using a large-scale test facility. Also a degree of the explosion due to a boilover burning during the fire was elucidated in the test. Test data in the report intend to use verify a computer code CELVA for the safety evaluation of air-ventilation system in the event of fire accident. (author).

22888 Plutonium recovery from spent reactor fuel by uranium displacement. Ackerman, J.P. To Dept. of Energy. 1991. Filed date 21 May 1991. USA patent application 7-703,641. 18p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. Order Number DE93011998. Source: OSTI; NTIS; GPO Dep.

This report discusses a process for separating uranium values and transuranic values from fission products containing rare earth values when the values which are contained together in a molten chloride salt electrolyte. A molten chloride salt electrolyte with a first ratio of plutonium chloride to uranium chloride is contacted with both a solid cathode and an anode having values of uranium and fission products including plutonium. A voltage is applied across the anode and cathode electrolytically to transfer uranium and plutonium from the anode to the electrolyte while uranium values in the electrolyte electrolytically deposit as uranium metal on the solid cathode in an amount equal to the uranium and plutonium transferred from the anode causing the electrolyte to have a second ratio of plutonium chloride to uranium chloride. Then the solid cathode with the uranium metal deposited thereon is removed and molten cadmium having uranium dissolved therein is brought into contact with the electrolyte resulting in chemical transfer of plutonium values from the electrolyte to the molten cadmium and transfer of uranium values from the molten cadmium to the electrolyte until the first ratio of plutonium chloride to uranium chloride is re-established.

22889 (WINCO–1093-Del.Ver.) **ICPP Special Fuels Canning and Characterization Facility.** Sire, D.L.; Bendixsen, C.L.; Armstrong, E.F.; Henry, R.N.; Frandsen, G.B. Westinghouse Idaho Nuclear Co., Inc., Idaho Falls, ID (United States). Apr 1992. 61p. Sponsored by USDOE, Washington, DC (United States); Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC07-84ID12435. Order Number DE93014821. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report examines the functional mission of a Special Fuels Canning and Characterization Facility (SFCCF) for the Idaho Chemical Processing Plant (ICPP) and presents justification for its implementation as part of Westinghouse Idaho Nuclear Co., Inc. (WINCO) long-range plans. The SFCCF would be built as the first phase of an overall facility for dispositioning special fuels. Issues related to feasibility, cost, and preconceptual design criteria are also discussed in this report. A preconceptual facility layout based on existing information was developed to enhance the preconceptual design criteria and support a rough order-of-magnitude cost estimate for the construction of the SFCCF. The US Department of Energy (DOE) is the landlord of a large quantity of spent nuclear fuel and related materials. A significant quantity of this inventory, approximately 730,000 kg total fuel mass, is labeled as "special fuel" because no specific processing technique and/or facility to disposition this material is available in the NMP complex. The dispositioning of this fuel is especially complex because of the variety of fuel types. Of these special fuels, approximately 90 %wt are stored at the INEL. Timely dispositioning of the fuels would avoid expenditures of funds for a second generation of storage facilities at the INEL and other DOE facilities and would demonstrate to the public that solutions to nuclear fuel dispositioning exist and that a plan is being executed. The SFCCF is required to characterize, verify the storage can contents, and, if necessary, recan the special fuels to help assure safe, interim storage (i.e. fission product containment and criticality control) until the special fuels processing facility is operating.

22890 (WSRC-TR–92-582-Rev.1) **Elucidation of noble metal/formic acid chemistry during DWPF feed preparation: Revision 1.** Landon, L.F. Westinghouse Savannah River Co., Aiken, SC (United States). [1991]. 126p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE93012791. Source: OSTI; NTIS; GPO Dep.

Eleven reports are included: evaluation of noble metal compounds as catalysts for aerobic decomposition of formic acid; reaction of $NaNO_3$ and $NaNO_2$ with formic acid under argon; effects of Ru, Rh, Pd chlorides on formic acid decomposition in presence of IDMS (pH=11.0) sludge; effects of additives on catalysts on decomposition of formic acid to hydrogen; Rh-catalyzed decomposition of formic acid; the question of whether this decomposition can be heterogeneous catalysis; inhibition of this reaction by additives; nitrilotriacetic acid inhibitor; uses of gelatin and other water soluble polymers to control flocculation rate; comparison of catalytic activities of Rh, Ru, Pd in Purex and HM sludges; experiments on homogeneous vs heterogeneous nature of Rh catalyst. Figs, refs, tabs.

0509 Transport, Handling, and Storage

Refer also to citation(s) 22949, 22982, 23065, 23131, 24144, 24149, 24150, 24172

22891 (CONF-930408–46) **Site and facility waste transport planning documents (SPDs) status and findings.** Schmid, S.P. (Science Applications International Corp., Oak Ridge, TN (United States)); Danese, F.L.; Wankerl, M.W. Oak Ridge National Lab., TN (United States). [1993]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From International high-level radioactive waste management conference; Las Vegas, NV (United States); 25-29 Apr 1993. Order Number DE93009721. Source: OSTI; NTIS; INIS; GPO Dep.

Site and Facility Waste Transportation Services Planning Documents (SPDS) are detailed desk-top reference documents that initiate planning for shipping commercial spent nuclear fuel (SNF) from the sites where it is currently generated and/or stored to another location. Because of the unique design features and individual variations in the spent fuel handling and cask loading operation requirements for each facility, one SPD will be written for each of the commercial facilities currently expected to deliver SNF into the Civilian Radioactive Waste Management System (CRWMS) disposal system. One primary purpose of an SPD is to initiate the discussions that will lead to a determination of the type of spent fuel cask and transport mode that will be used to transport spent fuel from each facility. The initial assessment of which cask type and mode would best serve each facility is based on the principle that the largest possible capacity casks should be used at the greatest number of facilities to reduce the total number of spent fuel shipments. The final selection of cask and transportation mode will be arrived at following discussion with the facility licensed operator. Once agreed upon by OCRWM and the facility owner, the SPD wig be used as a primary input to the development of a Site Specific Servicing Plan (SSSP) that will detail chosen servicing options for the individual site. This paper will discuss the purpose and development of SPDs and the preliminary results of an evaluation of the ability of delivering facilities to handle and ship spent fuel casks within the confines of the local nation infrastructure.

22892 (DOE/FTR–93012145) **[Meeting of the IAEA standing advisory group on safe transport of radioactive materials (SAGSTRAM)]: Foreign trip report, October 3–10, 1992.** Luna, R.E. Sandia National Labs., Albuquerque, NM (United States). 28 Oct 1992. 27p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. Order Number DE93012145. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This was the ninth meeting of SAGSTRAM, which is the primary advisory group to the IAEA on the conduct of their transportation safety program. At this meeting the author was an advisor to the DOE participant, F. P. Falci (EM-56). The meeting provided guidance to the Agency in many areas, but most important in this meeting were those associated with: the progress of the regulatory revision, interaction with the IMO on special requirements for ships carrying spent fuel,continuing changes to the LSA/LCO provisions in the regulations, and interactions with IAEA on the publication policy for transportation related documents.

22893 (DOE/LLW–160) **Savannah River Site offsite hazardous waste shipment data validation report.** Casey, C.; Kudera, D.E.; Page, L.A.; Rohe, M.J. EG and G Idaho, Inc., Idaho Falls, ID (United States). Feb 1993. 125p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-76ID01570. (INEL/MISC–93016). Order Number DE93012176. Source: OSTI; NTIS; INIS; GPO Dep.

The objective of data validation is to verify that waste shipments reported in response to the US Department of Energy Headquarters (DOE-HQ) data request are properly categorized according to DOE-HQ definitions. This report documents all findings and actions resulting from the independent review of the Savannah River Site (SRS) data submittal and provides a summary of the SRS data submittal and data validation strategy. The overall hazardous waste management and offsite release process from 1987 through 1991 is documented along with an identification and description of the hazardous waste generation facilities. The SRS did not ship any hazardous waste offsite before 1987. Sampling and analysis and surface surveying procedures and techniques used in determining offsite releasability of the shipments are also described in this report.

22894 (INIS-mf–13518, pp. LJ28) **Management of radioactive materials disposal in the Slovak Republic.** Palas, M. (Atomove Elektrarne Mochovce (Czechoslovakia)). 1992. [76p.] (In Czech). (CONF-9210351–: The mining town of Pribram in science and technology, Pribram (Czechoslovakia), 12-14 Oct 1992). In *The mining town of Pribram in science and technology. Abstracts of contributions.* Order Number DE93625342. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. SPENT FUEL STORAGE/storage facilities; SLOVAK REPUBLIC; SPECIFICATIONS

22895 (NEA-CRP-L–338) **NEACRP comparison of codes for the radiation protection assessment of transportation packages. Solutions to problems 5 and 6.** Locke, H.F. UKAEA Atomic Energy Establishment, Winfrith (United Kingdom). Materials Technology Div. Mar 1992. [32p.] Order Number DE93626122. Source: OSTI; NTIS (US Sales Only); INIS.

The results for Problems 5 and 6 of the NEACRP code comparison as submitted by six participating countries are presented in summary. These problems concentrate on the prediction of the neutron and gamma-ray sources arising in fuel after a specified irradiation, the fuel being uranium oxide for problem 5 and a mixture of uranium and plutonium oxides for problem 6. In both problems the predicted neutron sources are in good agreement for all participants. For gamma-rays however there are differences, largely due to the omission of bremstrahlung in some calculations. This discrepancy occurs at low energies and is not significant for shielding calculations, although it would be important for predicting heating rates in some circumstances.

22896 (NEA-CRP-L–339) **Summary of the results of the comparison of calculations and measurements for the TN12 flask carried out under the NEACRP intercomparison of shielding codes.** Locke, H.F. UKAEA Atomic Energy Establishment, Winfrith (United Kingdom). Materials Technology Div. Mar 1992. [46p.] Order Number DE93626123. Source: OSTI; NTIS (US Sales Only); INIS.

Measurements of neutron and gamma-ray dose-rates made outside a TN-12 flask loaded with 12 PWR fuel elements were chosen as an experimental benchmark for the NEACRP Intercomparison of Codes. The results of calculations carried out by eight participants are compared with the measured dose-rates. The agreement is mostly very good for the dose-points at the mid-height of the flask, although at positions opposite the top and bottom of the fuel there are bigger discrepancies. The latter are attributed to the greater uncertainties in defining the sources and the shield materials in these regions. The study demonstrated the need to use an accurate response function for the dosimeter rather than assuming it to have a true dose response. One area of inconsistency in the conclusions drawn by participants was in the need for explicit modelling of the copper fins on the outside of the steel flask. Further work is needed to resolve this. Overall the comparison shows that the methods of calculation are accurate in most cases, and gives confidence in their application to flask design.

22897 (ORNL/CSD/FTR–4423) **[Travel to Japan for the 10th international symposium on the packaging and transportation of radioactive materials]: Foreign trip report, September 14, 1992–October 2, 1992.** Whitesides, G.E. Oak Ridge National Lab., TN (United States). 16 Oct 1992. 23p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93012112. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report details a trip to Japan by an ORNL site manager. The purpose of the trip was to attend the 10th International Symposium on the Packaging and Transportation of Radioactive Materials (PATRAM '92) and to visit the Takai-mura facilities of the Japanese Atomic Energy Research Institute (JAERI), the Power Reactor and Nuclear Fuel Development Corporation (PNC), and the Nuclear Safety Research Association in Tokyo.

22898 (ORNL/FTR–4429) **[Safe transport of radioactive materials]: Foreign trip report, October 3–10, 1992.** Rawl, R.R. Oak Ridge National Lab., TN (United States). 26 Oct 1992. 39p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93009924. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The traveler participated in the ninth meeting of SAGSTRAM, the IAEA's senior advisory group on transportation safety matters. SAGSTRAM provides advice to the IAEA Director General concerning the direction and content of IAEA's transportation program. Several areas were discussed that have been identified as major issues related to the ongoing revision of the IAEA "Regulations for the Safe Transport of Radioactive Materials," Safety Series No. 6. Activities were initiated that will result in a complete revision of Safety Series No. 6 by 1996, and each major issue was reviewed to ensure that it will be adequately addressed during the revision process. Other aspects of the IAEA transportation program, such as information collection and coordinated research programs, were also reviewed, and advice was provided on future direction for these projects.

22899 (ORNL/FTR–4569) **[A trip to Austria to participate in the "Technical Committee on the Impact of the New ICRP Recommendations on the IAEA Regulations for the Safe Transport of Radioactive Materials"]: Foregin trip report, March 12–20, 1993.** Rawl, R.R. Oak Ridge National Lab., TN (United States). 5 Apr 1993. 33p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93011561. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The traveler participated in the second meeting of the IAEA Technical Committee TCM-M to consider the impacts of changes in the radiation protection recommendations of the International Commission on Radiological Protection (ICRP) on the IAEA transportation regulations. A few of the changes introduced in the new ICRP Publication 60 have the potential to cause significant impacts on the radiation protection-related approaches incorporated into the transport regulations. All of the new (or revised) ICRP recommendations were reviewed, and evaluations were made to determine if changes are needed in the transport regulations. In some cases, changes were needed; in others, justifications were developed for keeping the present transport requirements.

22900 (ORNL/TM–12090) **INTERLINE 5.0 – An expanded railroad routing model: Program description, methodology, and revised user's manual.** Johnson, P.E. (Oak Ridge National Lab., TN (United States)); Joy, D.S.; Clarke, D.B.; Jacobi, J.M. Oak Ridge National Lab., TN (United States). Mar 1993. 97p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93013471. Source: OSTI; NTIS; INIS; GPO Dep.

A rail routine model, INTERLINE, has been developed at the Oak Ridge National Laboratory to investigate potential routes for transporting radioactive materials. In Version 5.0, the INTERLINE routing algorithms have been enhanced to include the ability to predict alternative routes, barge routes, and population statistics for any route. The INTERLINE railroad network is essentially a computerized rail atlas describing the US railroad system. All rail lines, with the exception of industrial spurs, are included in the network. Inland waterways and deep water routes along with their interchange points with the US railroadsystem are also included. The network contains over 15,000 rail and barge segments (links) and over 13,000 stations, interchange points, ports, and other locations (nodes). The INTERLINE model has been converted to operate on an IBM-compatible personal computer. At least a 286 computer with a hard disk containing approximately 6 MB of free space is

recommended. Enhanced program performance will be obtained by using arandom-access memory drive on a 386 or 486 computer.

22901 (ORNL/TM–12124) **HIGHWAY 3.1: An enhanced HIGHWAY routing model: Program description, methodology, and revised user's manual.** Johnson, P.E. (Oak Ridge National Lab., TN (United States)); Joy, D.S.; Clarke, D.B.; Jacobi, J.M. Oak Ridge National Lab., TN (United States). Mar 1993. 106p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93013472. Source: OSTI; NTIS; GPO Dep.

The HIGHWAY program provides a flexible tool for predicting highway routes for transporting radioactive materials in the United States. The HIGHWAY data base is essentially a computerized road atlas that currently describes over 240,000 miles of highways. Complete descriptions of all Interstate System and most US highways (except those that parallel a nearby Interstate highway) are included in the data base. Many of the principal state highways and a number of local and county highways are also identified. The data base also includes locations of nuclear facilities and major airports. Several different types of routes may be calculated, depending on a set of user-supplied constraints. Routes are calculated by minimizing the total impedance between the origin and the destination. Basically, the impedance is defined as a function of distance and driving time along a particular highway segment. Several routing constraints can be imposed during the calculations. One of the special features of the HIGHWAY model is its ability to calculate routes that maximize use of Interstate System highways. This feature allows the user to predict routes for shipments of radioactive materials that conform to the US Department of Transportation routing regulations. Other features of the model include the ability to predict routes that bypass a specific state, city, town, or highway segment. Two special features have been incorporated in HIGHWAY, version 3.1. The first is the ability to automatically calculate alternative routes. Frequently, there are a number of routes between the source and destination that vary slightly in distance and estimated driving time. The HIGHWAY program offers a selection of different but nearly equal routes. The second special feature is the capability to calculate route-specific population density statistics. The population density distribution is calculated for each highway segment in the route and is reported on a state-by-state basis.

22902 (PNL-SA–21727) **Status of work at PNL supporting dry storage of spent fuel.** Cunningham, M.E.; McKinnon, M.A.; Michener, T.E.; Thomas, L.E.; Thornhill, C.K. Pacific Northwest Lab., Richland, WA (United States). Jan 1993. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-930182–1: 10. Institute of Nuclear Materials Management spent fuel management seminar, Washington, DC (United States), 13-15 Jan 1993). Order Number DE93007879. Source: OSTI; NTIS; INIS; GPO Dep.

This report discusses three projects related to dry storage of light-water reactor spent fuel which are being conducted at Pacific Northwest Laboratory. Performance testing of six dry storage systems (four metal casks and two concrete storage systems) has been completed and results compiled. Two computer codes for predicting spent fuel and storage system thermal performance, COBRA-SFS and HYDRA-II, have been developed and have been reviewed by the US Nuclear Regulatory Commission. Air oxidation testing of spent fuel was conducted from 1984 through 1990 to obtain data to support recommendations of temperature-time limits for air dry storage of spent light-water reactor fuel.

22903 (SAND–93-0469C) **Waste minimization/pollution prevention at R&D facilities: A cradle-to-grave tracking and information system for Sandia National Laboratories.** Kjeldgaard, E.A.; Gillenwater, M.W. Sandia National Labs., Albuquerque, NM (United States). [1993]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-930483–2: 9. waste minimization and pollution prevention conference, San Francisco, CA (United States), 13-15 Apr 1993). Order Number DE93011578. Source: OSTI; NTIS; INIS; GPO Dep.

Critical information required for Environment, Safety, and Health (ES&H) protection can be acquired with a comprehensive cradle-to-grave tracking and information system. The cradle-to-grave concept makes two initial assumptions. First, it is more effective to gather information at the origination of a process or entry point of a material and maintain that information during the rest of its life-cycle than to collect data on an ad hoc basis. Second, the information needs of the various ES&H programs have many commonalties. A system which adheres to a methodology based upon these assumptions requires a significant technical and administrative commitment; however, this investment, will in the long-term, reduce the effort and duplication of ES&H programs, improve the efficiency of ES&H and line personnel, and increase the scope and accuracy of ES&H data. The cradle-to-grave system being developed at Sandia National Laboratories (SNL) is designed to provide useful information on materials, personnel, facilities, hazards, wastes, and processes to fulfill the mission of pollution prevention, risk management, industrial hygiene, emergency preparedness, air/water quality, and hazardous and radioactive waste management groups. SNL is currently linking system modules, which are at various stages of development and production, to realize a cradle-to-grave tracking and information system that is functional for a large research and development laboratory.

22904 (UCRL-ID–110445) **A guide for thermal testing transport package for radioactive material: Hypothetical accident conditions.** VanSant, J.H.; Carlson, R.W.; Fischer, L.E.; Hovingh, J. Lawrence Livermore National Lab., CA (United States). 9 Feb 1993. 44p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE93008624. Source: OSTI; NTIS; INIS; GPO Dep.

This document provides guidelines for planning, conducting, and reporting thermal tests on transport packages for radioactive material. Test conditions and acceptance criteria are for the hypothetical accident conditions specified in Part 71 of Title 10 Code of Federal Regulations (10 CFR 71). All type B packages for transport of radioactive material must be tested to these conditions, by physical or analytical test, and meet the acceptance criteria for certification by a U.S. regulatory agency as being in compliance with federal safety standards. The principal objective of this Thermal Test Guide (TTG) is to provide an applicant with general recommendations for development of a physical test program. Also, the TTG is in accord with the general philosophy for reviewing safety analysis reports for packaging and provides a common basis for applicants and reviewers. As there can be a large variety of package designs, the TTG is not all-inclusive. An applicant should appropriately apply the TTG to ensure acceptable test conditions and results for a particular package design. Recommended test conditions are based on a proposed ruling of 10 CFR 71 that was published in the US Federal Register. Thermal test conditions in the proposed ruling exceed those specified in the current ruling. Also, they are effectively equivalent to thermal test conditions specified by the International Atomic Energy Agency (IAEA) for Type B packages. Thus, by following the TTG recommendations, an applicant would be assured of meeting future 10 CFR 71 requirements and also complying with IAEA requirements.

22905 (UCRL-JC–110999) **Truck accident involving unirradiated nuclear fuel.** Carlson, R.W.; Fischer, L.E. Lawrence Livermore National Lab., CA (United States). Jul 1992. 5p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9207102–77: Institute of Nuclear Materials Management (INMM) annual meeting, Orlando, FL (United States), 19-22 Jul 1992). Order Number DE93012488. Source: OSTI; NTIS; INIS; GPO Dep.

In the early morning of Dec. 16, 1991, a severe accident occurred when a passenger vehicle traveling in the wrong direction collided with a tractor trailer carrying 24 nuclear fuel assemblies in 12 containers on Interstate 1-91 in Springfield, Massachusetts. This paper documents the mechanical circumstances of the accident and the physical environment to which the containers were exposed and the response of the containers and their contents. The accident involved four impacts where the truck was struck by the car, impacted on the center guardrail, impacted on the outer concrete barrier and came to rest against the center guardrail. The impacts were followed by a fire that began in the engine compartment, spread to the.tractor and cab, and eventually spread to the trailer and payload. The fire lasted for about three hours and the packages were involved in the fire for about two hours. As a result

of the fire, the tractor-trailer was completely destroyed and the packages were exposed to flames with temperatures between 1300°F and 1800°F. The fuel assemblies remained intact during the accident and there was no release of any radioactive material during the accident. This was a very severe accident; however, the injuries were minor and at no time was the public health and safety at risk.

22906 (WHC-SA–1414) **Uranium hexafluoride packaging tiedown systems overview at Portsmouth Gaseous Diffusion Plant, Piketon, Ohio.** Becker, D.L.; Lindquist, M.R. Westinghouse Hanford Co., Richland, WA (United States). Mar 1993. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. (CONF-930702–20: Pressure vessel and piping conference, Denver, CO (United States), 25-29 Jul 1993). Order Number DE93013001. Source: OSTI; NTIS; INIS; GPO Dep.

The Portsmouth Gaseous Diffusion Plant (PORTS) in Piketon, Ohio operated by Martin Marietta Energy Systems, Inc., through the US Department of Energy-Oak Ridge Operations Office (DOE-ORO) for the US Department of Energy Headquarters, Office of Nuclear Energy. The PORTS conducts those operations that are necessary for the production, packaging, and shipment of enriched uranium hexafluoride (UF_6). Uranium hexafluoride enriched greater than 1.0 wt percent ^{235}U shall be packaged in accordance with the US Department of Transportation (DOT) regulations of Title 49 CFR Parts 173 (Reference 1) and 178 (Reference 2), or in US Nuclear Regulatory Commission (NRC) or US Department of Energy (DOE) certified package designs. Concerns have been expressed regarding the various tiedown methods and condition of the trailers being used by some shippers/carriers for international transport of the UF_6 cylinders/overpacks (Reference 3). Because of the concerns about international shipments, the US Department of Energy-Headquarters (DOE-HQ) Office of Nuclear Energy, through DOE-HQ Transportation Management Division, requested Westinghouse Hanford Company (Westinghouse Hanford) to review UF_6 packaging tiedown and shipping practices used by PORTS, and where possible and appropriate, provide recommendations for enhancing these practices. Consequently, a tram of two individuals from Westinghouse Hanford visited PORTS on March 5 and 6, 1990, for the purpose of conducting this review. The paper provides a brief discussion of the review activities and a summary of the resulting findings and recommendations. A detailed reporting of the review is documented in Reference 4.

22907 (WHC-SA–1867) **Risk management of onsite transportation of nuclear waste.** Field, J.G.; Wang, O.S.; Mercado, J.E. Westinghouse Hanford Co., Richland, WA (United States). Mar 1993. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. (CONF-930608–2: Safewaste '93: the final disposal of nuclear waste, Avignon (France), 14-18 Jun 1993). Order Number DE93011352. Source: OSTI; NTIS; INIS; GPO Dep.

The United States Department of Energy (DOE) Hanford Site recently has undergone a significant change in mission. The focus of operations has shifted from plutonium production to environmental restoration. This transition has caused a substantial increase in quantities of nuclear waste and other hazardous materials packaged and transported onsite. In response to the escalating transportation activity, Westinghouse Hanford Company (Westinghouse Hanford), the Hanford Site operations and engineering contractor, is proposing an integrated risk assessment methodology and risk management strategy to enhance the safety of onsite packaging and transportation operations involving nuclear waste. The proposed methodology consists of three integral parts: risk assessment, risk acceptance criteria, and risk minimization. The purpose of the methodology is to ensure that the risk for each ongoing transportation activity is acceptable and to minimize the overall risk for current and future onsite operations.

22908 (WSRC-TR–93-001) **P-V-T-C accuracy for RTF metal hydride bed callbration.** Klein, J.E. Westinghouse Savannah River Co., Aiken, SC (United States). 15 Jan 1993. 34p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE93013693. Source: OSTI; NTIS (US Sales Only); GPO Dep.

SRCT was asked to determine the accuracy of pressure-volume temperature-composition (P-V-T-C) calculations for the RTF mix tanks so bed loading accuracies for the in-bed accountability (IBA) Test Acceptance Criteria for RTF start-up could be defined. To meet the 4-to-1 calibration accuracy ratio (CAR) requirement for the hydride beds, the uncertainties in the P-V-T-C calculations needed to be four times greater than tritium measurement uncertainty using the IBA technique. To meet the 4-to-1 CAR for the two "large size" RTF metal hydride storage beds, only procedural changes are needed to raise the CAR from 2.5-to-1 to 4.4-to-1. It is recommended that the large size bed IBA calibration procedures be revised to use the method described in this report. For the "normal size" hydride beds, the 4-to-1 CAR can not be met with the current equipment, and three options for RTF start-up are available: first, obtain a waiver to approve a CAR of 1.6-to-1; second, improve the CAR to 3.3-to-1 by temporary use (during IBA calibrations) of a lower pressure range (1000 torr), high accuracy (± 1.5 torr), pressure transducer for 1500 L RTF mix tank pressures (waiver still required); and third, improve the CAR to 4.4-to-1 by temporary use (during IBA calibrations) of a lower pressure range (1000 torr), high accuracy (± 1.5 torr), pressure transducer for the 1000 L RTF mix tank pressures (waiver not required). Option one is undesirable due to its low accuracy, while option three, the calibration of the six normal size hydride beds using the one 1000 L mix tank, will take longer than is practical based on the RTF start-up schedule. It is recommended that 1000 ± 1.5 torr pressure transducers be temporarily used on the 1500 L mix tanks for IBA calibrations of the normal size beds and a waiver be requested justifying a CAR of 3.3-to-1.

0510 Economic, Industrial, and Business Aspects

Refer also to citation(s) 22864, 23009, 23010

22909 (ANL/EAIS/TM–88) **Analysis of the formation, expression, and economic impacts of risk perceptions associated with nuclear facilities.** Allison, T.; Hunter, S.; Calzonetti, F.J. Argonne National Lab., IL (United States). Environmental Assessment and Information Sciences Div. Oct 1992. 79p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. Order Number DE93010594. Source: OSTI; NTIS; INIS; GPO Dep.

This report investigates how communities hosting nuclear facilities form and express perceptions of risk and how these risk perceptions affect local economic development. Information was collected from site visits and interviews with plant personnel, officials of local and state agencies, and community activists in the hosting communities. Six commercial nuclear fuel production facilities and five nuclear facilities operated for the US Department of Energy by private contractors were chosen for analysis. The results presented in the report indicate that the nature of risk perceptions depends on a number of factors. These factors are (1) level of communication by plant officials within the local community, (2) track record of the facility. operator, (3) process through which community and state officials receive information and form opinions, (4) level of economic links each plant has with the local community, and (15) physical characteristics of the facility itself. This report finds that in the communities studied, adverse ask perceptions have not affected business location decisions, employment levels in the local community, tourism, or agricultural development. On the basis of case-study findings, this report recommends that nuclear facility siting programs take the following observations into account when addressing perceptions of risk. First, the quality of a facility's participation with community activists, interest groups, and state agencies helps to determine the level of perceived risk within a community. Second, the development of strong economic links between nuclear facilities and their host communities will produce a higher level of acceptance of the nuclear facilities.

22910 (SR/H–526) **[Hanford Department Histories]: Village Operation, Part 2.** Plant Histories. Hanford Engineer Works, Richland, WA (United States). [1946]. 132p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. Order Number DE93012420. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Village Administration experience with respect to commercial facilities prior to July 1, 1945 is reviewed in a previous memorandum. The purpose of this present memorandum is to continue the review of Commercial Facilities Division activities through December 1945. Organizational considerations and related accounts of other Village Administration experience (e.g., housing and community activities) have been covered separately.

0520 Waste Management

Refer also to citation(s) 22865, 22880, 22891, 22893, 22907, 23090, 23096, 23099, 23103, 23104, 23105, 23129, 23132, 23133, 23145, 23370, 23542, 23886, 23950, 23962, 23990, 24122, 24138, 24145, 24151, 24567, 24584, 24748, 24766, 24784, 24788, 24791, 25398

22911 (ANL/CMT/CP–77655) **Study on the colloids generated from testing of high-level nuclear waste glasses.** Feng, X.; Buck, E.C.; Mertz, C.; Bates, J.K.; Cunnane, J.C.; Chaiko, D.J. Argonne National Lab., IL (United States). [1993]. 20p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-930205–18: Waste management '93, Tucson, AZ (United States), 28 Feb - 4 mar 1993). Order Number DE93008655. Source: OSTI; NTIS; INIS; GPO Dep.

The generation of colloids in the interaction of high-level nuclear waste glasses with groundwater at 90°C has been investigated. The stability of the colloidal suspensions has been characterized with respect to salt concentration, pH time, particle size, and zeta potential. The compositions and the morphology of the colloids have also been determined with transmission electron microscopy (TEM). From ourtest results combined with earlier ones, we conclude that the waste glass may contribute to the colloid formation by increasing ion concentration in groundwater, which causes nucleation of colloids; by releasing radionuclides that adsorb onto existing groundwater colloids; and by spalling colloidal-size fragments from the surface layer of the reacted glass. The colloids are silicon-rich particles, such as smectites and uranium silicates. When the salt concentration in the solution is high the colloidal suspensions agglomerate. However, the agglomerated particles can be resuspended if the salt concentration is lowered by dilution with groundwater. The colloids agglomerate quickly after the leachate is cooled to room temperature. Most of the colloids settle out of the solution within a few days at ambient temperature. The isoelectric point is at a pH of approximately 1.0. Between pH 1 and 10.5, the colloids are negatively charged, which suggests that they will deposit readily on, positively charged surfaces. The average particle size islargest at the isoelectric point and is smallest around pH 6.

22912 (ANL/CMT/CP–79163) **Factors influencing chemical durability of nuclear waste glasses.** Feng, Xiangdong; Bates, J.K. Argonne National Lab., IL (United States). [1993]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-9303134–1: 9. international conference on advanced science and technology, Schaumburg, IL (United States), 27 Mar 1993). Order Number DE93009983. Source: OSTI; NTIS; INIS; GPO Dep.

A short summary is given of our studies on the major factors that affect the chemical durability of nuclear waste glasses. These factors include glass composition, solution composition, SA/V (ratio of glass surface area to the volume of solution), radiation, and colloidal formation. These investigations have enabled us to gain a better understanding of the chemical durability of nuclear waste glasses and to accumulate.a data base for modeling the long-term durability of waste glass, which will be used in the risk assessment of nuclear waste disposal. This knowledge gained also enhances our ability to formulate optimal waste glass compositions.

22913 (ANL/CMT/CP–79523) **Applications of microwave radiation environmental remediation technologies.** Krause, T.R.; Helt, J.E. Argonne National Lab., IL (United States). Chemical Technology Div. [1993]. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-930438–12: 95. annual meeting of the American Ceramic Society, Cincinnati, OH (United States), 18-22 Apr 1993). Order Number DE93012903. Source: OSTI; NTIS; INIS; GPO Dep.

A growing number of environmental remediation technologies (e.g., drying, melting, or sintering) utilize microwave radiation as an integral part of the process. An increasing number of novel applications, such as sustaining low-temperature plasmas or enhancing chemical reactivity, are also being developed. An overview of such technologies being developed by the Department of Energy is presented. A specific example being developed at Argonne National Laboratory, microwave-induced plasma reactors for the destruction of volatile organic compounds, is discussed in more detail.

22914 (ANL/EAIS/CP–78642) **Managing nuclear waste: Social and economic impacts.** Hemphill, R.C. (Argonne National Lab., IL (United States)); Bassett, G.W. Jr. Argonne National Lab., IL (United States); Chicago Univ., IL (United States). Dept. of Economics. [1993]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-930408–54: International high-level radioactive waste management conference, Las Vegas, NV (United States), 25-29 Apr 1993). Order Number DE93009953. Source: OSTI; NTIS; INIS; GPO Dep.

Recent research has focused on perceptions of risk dominant source of economic impacts due to siting a high level radioactive waste facility. This article addresses the social and economic considerations involved with the issue of risk perception and other types of negative imagery. Emphasis is placed on ways of measuring the potential for economic effects resulting from perceptions prior to construction and operation of a HLW facility. We describe the problems in arriving at defensible estimates of economic impacts. Our review has found that although legal and regulatory bases may soon allow inclusion of these impacts in EIS and for compensation purposes, credible scientific methods do not currently exist for predicting the existence or magnitude of changes in economic decision-making. Policy-makers should recognize the potential for perception-based economic impacts in determining the location and means of managing radioactive waste; but, they also need be cognizant of the current limitations of quantitative estimates of impacts in this area.

22915 (ANL/EAIS/TM–89) **Postremediation dose assessment for the Elza Gate site, Oak Ridge, Tennessee.** Nimmagadda, M.; Yu, C. Argonne National Lab., IL (United States). Environmental Assessment and Information Sciences Div. Mar 1993. 20p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. Order Number DE93011504. Source: OSTI; NTIS; GPO Dep.

Potential maximum radiation dose rates were calculated for the Elza Gate site in Oak Ridge, Tennessee. The RESRAD computer code, which implements the methodology described in the US Department of Energy's manual for implementing residual radioactive material guidelines, was used in this evaluation. Currently, the site is not being used. Four potential future use scenarios were considered for the Elza Gate site; the scenarios vary with regard to time spent at the site, sources of water used, and sources of food consumed. In Scenario A (the expected scenario), industrial use of the site is assumed; in Scenario B (a plausible scenario), recreational use of the site is assumed. Both Scenarios C and D (possible but unlikely scenarios) assume the presence of a resident farmer in the immediate vicinity of the site. The difference between Scenarios C and D is the source of water used. For Scenario C, an adjacent pond provides 100% of the water for drinking, irrigation, and raising livestock; for Scenario D, groundwater drawn from a well located at the downgradient edge of the contaminated zone is the only source of water for drinking, investigation, and raising livestock. The results of the evaluation indicate that the US Department of Energy dose limit of 100 mrem/yr would not be exceeded for any scenario. The potential maximum dose rates for Scenarios A, B, C, and D are 1.5, 0.66, 12, and 42 mrem/yr, respectively.

22916 (ANL/MCT/CP–75243) **Crack growth behavior of candidate waste container materials in simulated underground water.** Park, J.Y.; Shack, W.J.; Diercks, D.R. Argonne National Lab., IL (United States). [1992]. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-921119–3: American Society for Testing and Materials (ASTM) symposium on application of accelerated corrosion tests to life prediction of materials, Miami, FL (United States), 16-17 Nov

1992). Order Number DE93008648. Source: OSTI; NTIS; INIS; GPO Dep.

Fracture-mechanics crack growth tests were conducted on 25.4-mm-thick compact tension specimens of Types 304L and 316L Stainless steel and Incoloy 825 at 93°C and 1 atmosphere of pressure in simulated J-13 well water, which is representative of the groundwater at the Yucca Mountain site in Nevada that is proposed for a high-level nuclear waste repository. Crack growth rates were measured under various load conditions: load ratios of 0.2–1.0, frequencies of 2×10^{-4}–1 Hz, rise times of 1–5000 s, and peak stress intensities of 25–40 MPa·m$^{\frac{1}{2}}$. The measured crack growthrates are bounded by the predicted rates from the current ASME Section 11 correlation for fatigue crack growth rates of austenitic stainless steel in air. Environmentally accelerated crack growth was not evident in any of the three materials under the test conditions investigated.

22917 (ASD-NMP–93-0014) **Implementation impacts of PRL methodology.** Caudill, J.A.; Krupa, J.F.; Meadors, R.E.; Odum, J.V.; Rodrigues, G.C. Westinghouse Savannah River Co., Aiken, SC (United States). Feb 1993. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE93013659. Source: OSTI; NTIS; INIS; GPO Dep.

This report responds to a DOE-SR request to evaluate the impacts from implementation of the proposed Plutonium Recovery Limit (PRL) methodology. The PRL Methodology is based on cost minimization for decisions to discard or recover plutonium contained in scrap, residues, and other plutonium bearing materials. Implementation of the PRL methodology may result in decisions to declare as waste certain plutonium bearing materials originally considered to be a recoverable plutonium product. Such decisions may have regulatory impacts, because any material declared to be waste would immediately be subject to provisions of the Resource Conservation and Recovery Act (RCRA). The decision to discard these materials will have impacts on waste storage, treatment, and disposal facilities. Current plans for the de-inventory of plutonium processing facilities have identified certain materials as candidates for discard based upon the economic considerations associated with extending the operating schedules for recovery of the contained plutonium versus potential waste disposal costs. This report evaluates the impacts of discarding those materials as proposed by the F Area De-Inventory Plan and compares the De-Inventory Plan assessments with conclusions from application of the PRL. The impact analysis was performed for those materials proposed as potential candidates for discard by the De-Inventory Plan. The De-Inventory Plan identified 433 items, containing approximately 1% of the current SRS Pu-239 inventory, as not appropriate for recovery as the site moves to complete the mission of F-Canyon and FB-Line. The materials were entered into storage awaiting recovery as product under the Department's previous Economic Discard Limit (EDL) methodology which valued plutonium at its incremental cost of production in reactors. An application of Departmental PRLs to the subject 433 items revealed that approximately 40% of them would continue to be potentially recoverable as product plutonium.

22918 (BfS-ET–14/92-REV-1) **Requirements on radioactive wastes to be disposed and measures for product control of radioactive wastes - Morsleben repository for radioactive wastes (ERAM) - as of November 1992.** Kugel, K. (Bundesamt fuer Strahlenschutz, Braunschweig (Germany). Fachbereich Nukleare Entsorgung und Transport); Noack, W.; Bard, C.; Giller, H.; Martens, B.R. Bundesamt fuer Strahlenschutz, Salzgitter (Germany). Mar 1993. 107p. (In German). Order Number DE93795327. Source: OSTI; NTIS (US Sales Only); INIS.

The waste categories 'solid wastes' and 'sealed sources' can be emplaced in the Morsleben repository (ERAM). The requirements on the wastes to be disposed of must be fulfilled by the waste producer upon delivery of the wastes. Concerning solid wastes, requirements on the waste forms and activity limitations for radionuclides and radionuclide groups must be fulfilled. Furthermore, requirements on packagings must be kept. Concerning sealed sources, basic requirements must be fulfilled and activity limitations depending on their packaging must be kept. Some radionuclides contained in the wastes must be indicated. The fulfilment of the requirements on radioactive wastes to be disposed of is proved within the framework of the waste package quality control. Organizational and administrative regulations and the check and control measures performed within the framework of the waste package quality control are described. The fulfilment of the requirements is proved by the qualification of conditioning procedures and following independent control measures performed during conditioning or by a random sampling inspection of waste packages. Furthermore, independent control measures at waste containers are performed. (orig.).

22919 (BfS-ET–17/93) **Amount of radioactive wastes in the Federal Republic of Germany - waste inquiry for the year 1991.** Hollmann, A.; Brennecke, P. Bundesamt fuer Strahlenschutz, Braunschweig (Germany). Fachbereich Nukleare Entsorgung und Transport. Feb 1993. 29p. (In German). Order Number DE93792571. Source: OSTI; NTIS (US Sales Only); INIS.

On behalf of the Ministry for Environment, Nature Conservation and Nuclear Safety the amount of radioactive wastes arising in the Federal Republic of Germany is surveyed every year by the Federal Office for Radiation Protection (BfS). This survey includes residues and primary wastes, as well as the amounts of arising and already existing conditioned wastes, and, moreover, a prognosis for the following year. It comprises the results of this investigation for the year 1991 and a prognosis for the radioactive waste to be expected in the future up to and including the year 2000, as well as considerations concerning the capacity of interim waste storages at the institutions liable to hand in their waste. For the time being BfS pursues the Konrad and Gorleben repository projects. Additionally, the Morsleben repository (ERAM) is prepared for the emplacement of radioactive wastes with comparably low-alpha activities. (orig.).

22920 (BNL–48607) **Polyethylene encapsulation of single shell tank low-level wastes.** Kalb, P.D.; Fuhrmann, M.; Colombo, P. Brookhaven National Lab., Upton, NY (United States). [1993]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-930205–56: Waste management '93, Tucson, AZ (United States), 28 Feb - 4 mar 1993). Order Number DE93010868. Source: OSTI; NTIS; INIS; GPO Dep.

Polyethylene encapsulation is being explored for potential use in treating nitrate salts and sludges at US Department of Energy (US DOE) underground storage tank facilities. Some of these wastes contain high concentrations of fission products and are expected to maintain equilibrium temperatures of 50–70°C for many years. The potential effects of elevated temperature and high radiation conditions on key waste form properties (e.g., mechanical integrity, leachability) are examined. After 6 months of thermal conditioning, waste form tests specimens show no degradation in mechanical integrity. Leaching at elevated temperature resulted in a small increase in leach rate (a factor of less than two), while diffusion remained the dominant mechanism of release. Full-scale polyethylene waste forms containing 50–70 wt % nitrate salt can be expected to leach a total of 5–17% of the original contaminant source term after 300 years of leaching under worst-case conditions (fully saturated at 70°C).

22921 (BNL–52361) **Seismic design and evaluation guidelines for the Department of Energy high-level waste storage tanks and appurtenances.** Bandyopadhyay, K.; Cornell, A.; Costantino, C.; Kennedy, R.; Miller, C.; Veletsos, A. Brookhaven National Lab., Upton, NY (United States). Jan 1993. 321p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. Order Number DE93011793. Source: OSTI; NTIS; INIS; GPO Dep.

This document provides guidelines for the design and evaluation of underground high-level waste storage tanks due to seismic loads. Attempts were made to reflect the knowledge acquired in the last two decades in the areas of defining the ground motion and calculating hydrodynamic loads and dynamic soil pressures for underground tank structures. The application of the analysis approach is illustrated with an example. The guidelines are developed for specific design of underground storage tanks, namely double-shell structures. However, the methodology discussed is applicable for other types of tank structures as well. The application of these and of suitably adjusted versions of these concepts to other structural types will be addressed in a future version of this document.

22922 (BNL–52365) **Polyethylene encapsulation of single-shell tank low-level wastes: Annual progress report.** Kalb, P.D.; Fuhrmann, M.; Cassidy, J.; Colombo, P.; Franz, E.M.; Fuhrmann, M.; Heiser, J. III; Kalb, P.D.; Klages, J.; Pietrzak, R. Brookhaven National Lab., Upton, NY (United States). Sep 1992. 53p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. Order Number DE93012805. Source: OSTI; NTIS; INIS; GPO Dep.

This report describes work supported by the UST-ID, conducted at Brookhaven National Laboratory I (BNL), to develop and demonstrate a polyethylene waste encapsulation process for low-level radioactive (LLW) and hazardous mixed wastes (HMW) stored in underground tanks. During FY 1992, studies were completed on the effects of elevated temperature on waste form integrity, strength and leachability. No changes in waste form integrity or compressive yield strength were detected after storing polyethylene waste forms containing 50, 60 and 70 wt% sodium nitrate at 70°C for 3 months. Leaching of polyethylene waste forms with similar nitrate salt loadings at temperatures up to 70°C resulted in slight increases in leachability (< a factor of 2), compared with leaching at ambient temperatures. Leaching of sodium nitrate from polyethylene waste forms was diffusion-controlled, enabling extrapolation of laboratory leach data to full-scale waste forms over long time periods. Full-scale polyethylene waste forms containing 50 to 70 wt% nitrate salt could be expected to leach a total of 5% to 17% of the original contaminant source term after 300 years of leaching under worst-case (70°C, fully saturated) conditions. This is about 25 to 75 times lower leachability than conventional cement grout waste forms containing a maximum of 20 wt% nitrate salts.

22923 (CEA-CONF–11231) **Balance carried out on an alpha waste incinerator in order to qualify its filtration system.** Cartier, R. (CEA Centre d'Etudes de la Vallee du Rhone, 30 - Marcoule (France). Dept. des Procedes de Retraitement); Burghofer, P.; Tregoures, A.; Maurel, J.M.; Vendel, J. CEA Centre d'Etudes de la Vallee du Rhone, 30 - Marcoule (France). Dept. des Procedes de Retraitement. 1991. [17p.] (CONF-910559–: 10. annual international incineration conference: environmental concerns and controls, Knoxville, TN (United States), 13-17 May 1991). Order Number DE93626417. Source: OSTI; NTIS (US Sales Only); INIS.

A balance was carried out on a pilot incinerator of inactive solid waste running at 4 kg/h. Various measurements were taken in order to qualify the prefiltration system of the incineration process operating by pyrolysis, afterburning and calcination: determining the ventilation characteristics of the plant (gas flow rates and residence time) and the physico-chemical characteristics of the effluent (mass flow and granulometric range of particles, chemical composition of gases). Various methods of sampling and of analyzing the gases were adopted and a thermochemical model was produced. Its results are reasonably close to the experimental measurements. The emission consists of submicronic particles and porous layers are the best adapted cleaning system.

22924 (CONF-920791–, pp. 6, Paper 15) **Remote chemical characterization.** Mech, S.J.; Reich, F.R.; Winkelman, W.D. US-DOE Assistant Secretary for Environmental Restoration and Waste Management, Washington, DC (United States). Jul 1992. From Information exchange meeting on characterization sensors and monitoring technologies; Dallas, TX (United States); 15-16 Jul 1992. In *Proceedings of the information exchange meeting on characterization, sensors, and monitoring technologies.* 261p. Order Number DE93005318. Source: OSTI; NTIS.

To support the safe and environmentally responsible operation and surveillance of the hazardous wastes at Hanford, new and innovative technology must be implemented. An important class of technology, referred to as remote sensing, will allow non-contacting sensing and characterization of materials in place. A technology of specific interest is non-contacting, optical spectroscopy. In general this method records the light reflectance and transmission properties of materials in the infrared region of the electromagnetic spectrum and analyzes this information to perform chemical and mineralogical identification and characterization. Such material has a unique spectroscopy fingerprint.

22925 (CONF-920791–, pp. 7, Paper 16) **Integrated instrument platform for in situ characterization of tank wastes.** DeLisle, G.V. (Westinghouse Hanford Co., Richland, WA (US)). USDOE Assistant Secretary for Environmental Restoration and Waste Management, Washington, DC (United States). Jul 1992. From Information exchange meeting on characterization sensors and monitoring technologies; Dallas, TX (United States); 15-16 Jul 1992. In *Proceedings of the information exchange meeting on characterization, sensors, and monitoring technologies.* 261p. Order Number DE93005318. Source: OSTI; NTIS.

Development of the Integrated Instrument Platform (IIP) for In-situ Characterization of Tank Wastes is one of many activities supporting the Underground Storage Tanks Integrated Demonstration (UST-ID). The overall summary work scope, planning, and funding guidance is provide in Technical Task Plan (TTP) RL421211. Success of this TTP is dependent on characterization and deployment technologies being developed as part of several separate TTPs and private industries. A key sub-task of this TTP is to identify those technologies that are applicable, transfer them, and integrate them into a complete and working system.

22926 (CONF-930205–17) **US Department of Energy, Office of Technology Development, mixed-waste treatment research, development, demonstration, testing, and evaluation.** Berry, J.B. (Oak Ridge National Lab., TN (United States)); Backus, P.M.; Conley, T.B.; Coyle, G.J.; Lurk, P.W.; Wolf, S.M. Oak Ridge National Lab., TN (United States). [1993]. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From Waste management '93; Tucson, AZ (United States); 28 Feb - 4 mar 1993. Order Number DE93007862. Source: OSTI; NTIS; INIS; GPO Dep.

Department of Energy (DOE) mixed waste is contaminated with both chemically hazardous and radioactive species. The DOE is responsible for regulating radioactive species while the Environmental Protection Agency (EPA) is responsible for regulating hazardous species. Dual regulations establish treatment standards and therefore affect the treatment technologies used to process mixed waste. This duality is reflected in technology development initiatives. Significant technology development has been conducted for either radioactive or hazardous waste, but limited technology development, specifically addressing mixed waste treatment issues, has been completed. Technology has not been designed, developed, demonstrated, or tested to produce a low-risk final waste form that increases the probability that the final waste form will be disposed.

22927 (CONF-930205–53) **Planning for and managing environmental restoration waste.** Miller, J.Q. Oak Ridge National Lab., TN (United States). [1993]. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400 ;AC05-76OR00001. From Waste management '93; Tucson, AZ (United States); 28 Feb - 4 mar 1993. Order Number DE93009726. Source: OSTI; NTIS; INIS; GPO Dep.

This paper describes the approach used to support the management of environmental restoration (ER) waste. A general description is provided of the tools and techniques that have been developed and applied to produce waste generation forecast data and treatment, storage, and disposal capacity needs. The ER Program can now consistently manage ER waste streams from initial generation through ultimate disposal. Utilizing the valuable information that results from application of strategically planned systems and techniques demonstrates the ability to provide the necessary waste management support for the ER cleanup process.

22928 (CONF-930364–1) **Development of treatment technologies for the processing of US Department of Energy mixed waste.** Backus, P.M. (Oak Ridge National Lab., TN (United States)); Berry, J.B.; Coyle, G.J.; Lurk, P.W.; Wolf, S.M. Oak Ridge National Lab., TN (United States). [1993]. 38p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From Spring national meeting of the American Institute of Chemical Engineers; Houston, TX (United States); 28 Mar - 1 apr 1993. Order Number DE93010831. Source: OSTI; NTIS; INIS; GPO Dep.

Waste contaminated with chemically hazardous and radioactive species is defined as mixed waste. Significant technology development has been conducted for separate treatment of hazardous and radioactive waste, but technology development addressing mixed-waste treatment has been limited. Management of mixed waste

requires treatment which must meet the standards established by the US Environmental Protection Agency for the specific hazardous constituents while also providing adequate control of the radionuclides. Technology has not been developed, demonstrated, or tested to produce a low-risk final waste form specifically for mixed waste. Throughout the US Department of Energy (DOE) complex, mixed waste is a problem because definitive treatment standards have not been established and few disposal facilities are available. Treatment capability and capacity are also limited. Site-specific solutions to the management of mixed waste have been initiated; however, site-specific programs result in duplication of technology development between various sites. Significant progress is being made in developing technology for mixed waste under the Mixed Waste Integrated Program. The status of the technical initiatives in chemical/physical treatment, destruction/stabilization technology, off-gas treatment, and final waste form production/assessment is described in this paper.

22929 (CONF-930396–10) **Potential impact of DOE's performance objective for protection of inadvertent intruders on low-level waste disposals at Oak Ridge National Laboratory.** Kocher, D.C. Oak Ridge National Lab., TN (United States). [1993]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From Waste management '93; Tucson, AZ (United States); 1-5 Mar 1993. Order Number DE93010823. Source: OSTI; NTIS; INIS; GPO Dep.

Performance objectives for disposal of low-level radioactive waste at Department of Energy (DOE) sites include limits on radiation dose to inadvertent intruders. This paper investigates the potential impact of DOE's performance objective for protection of inadvertent intruders on the acceptability of low-level waste disposals at Oak Ridge National Laboratory (ORNL). The analysis is based on waste volumes and radionuclide inventories for recent disposals and estimated doses to an inadvertent intruder for assumed exposure scenarios. The analysis indicates that more than 99% of the total volume of waste in recent disposals meets the performance objective for inadvertent intruders, and the volume of waste found to be unacceptable for disposal is only about 16 m^3. Therefore, DOE's performance objective for protection of inadvertent intruders probably will not have unreasonably adverse impacts on acceptable waste disposals at ORNL.

22930 (CONF-930408–69) **Using QA classification to guide design and manage risk.** Lathrop, J. (Strategic Insights, Los Altos, CA (United States)); DeKlever, R.; Petrie, E.H. Raytheon Services Nevada, Las Vegas, NV (United States). 28 Jan 1993. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC08-91NV10833. From International high-level radioactive waste management conference; Las Vegas, NV (United States); 25-29 Apr 1993. Order Number DE93012990. Source: OSTI; NTIS; INIS; GPO Dep.

Raytheon Services Nevada has developed a classification process based on probabilistic risk assessment, using accident/impact scenarios for each system classified. Initial classification analyses were performed for the 20 systems of Package IA of the Exploratory Studies Facility (ESF). The analyses demonstrated a solid, defensible methodological basis for classification which minimizes the use of direct engineering judgment. They provide guidance for ESF design and risk management through the identification of: The critical characteristics of each system that need to be controlled; and the parts of the information base that most need to be further developed through performance assessment or other efforts.

22931 (CORR–83-0124-Del.Ver.) **Savannah River Plant Nuclear Material Production and Defense Waste Management Facilities upgrading study, Savannah River Plant: First annual reappraisal.** Du Pont de Nemours (E.I.) and Co., Aiken, SC (United States). Savannah River Plant. Jan 1980. 80p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035 ;AC09-76SR00001. Order Number DE93009747. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document reports the results of an appraisal of the condition of equipment in the facilities operated by Du Pont at the Savannah River Plant for the Department of Energy.

22932 (DOE/DP/00789–T268) **Test plan: WIPP Materials Interface Interactions Test (MIIT).** Molecke, M.A. (Sandia National Labs., Albuquerque, NM (United States)); Wicks, G.G. Sandia National Labs., Albuquerque, NM (United States); Savannah River Lab., Aiken, SC (United States). Jul 1986. 156p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. Order Number DE93012199. Source: OSTI; NTIS; INIS; GPO Dep.

The WIPP Materials Interface Interactions Test (MIIT) multinational, cooperative, in situ experiments to be replaced in the Waste Isolation Pilot Plant (WIPP) starting in 1986. The MIIT involves the in situ evaluation of various waste package materials interactions in a repository-relevant, brine environment. The predominant emphasis in these tests is (1) to assess the performance.of defense high-level waste glass representative of that to be produced at the Defense Waste Processing Facility (DWPF), and (2) to obtain a fuller understanding of the relative behavior of this glass by comparing it to the behavior of many other high-level and transuranic glass waste forms in an Identical salt repository environment. For the purpose of ed to denote waste glass behavior this Test Plan, the term "performance" is used in the specific environment considered or tested. The tested glass waste forms come from various US and foreign laboratories. This assessment involves the long-term, in situ leaching and surface interactions testing in brine, in boreholes in the WIPP, at 90°C. It is anticipated that segments of the WIPP MIIT will continue for as long as 5 years. All glass waste forms used in this test series are nonradioactive.

22933 (DOE/DP/00789–T273) **Test plan: WIPP simulated CH and RH TRU waste tests: Technology experiments (TRU TE) (Container durability, backfill interactions, and nuclide migration).** Molecke, M.A. Sandia National Labs., Albuquerque, NM (United States). Apr 1986. 127p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. Order Number DE93012204. Source: OSTI; NTIS; GPO Dep.

The WIPP Simulated CH and RH TRU Waste Tests are a collection of related technology experiments and operational demonstrations. These technology experiments (TE) evaluate the in situ durability or containment integrity (i.e., the corrosion behavior and crush resistance) of contact-handled transuranic waste (CH TRU) drums and remote-handled transuranic waste (RH TRU) canisters. Also to be evaluated are the interactions of the waste containers and several backfill materials, and the migration behavior 'of nonradioactive, chemical tracers representative of radionuclides eventually released from the waste containers in the long term. The behavior of TRU waste forms will not be evaluated in these tests. The degradation behavior of TRU waste matrices was characterized previously in the laboratory, and is reviewed in Section 9.1. All CH TRU drums and RH TRU canisters used in these tests are simulated only in the sense that they contain no radioactive materials.

22934 (DOE/DP/00789–T274) **Test plan: Air intake shaft performance test – Addendum for obtaining cores in the Culebra for radionuclide retardation studies.** Gelbard, F. Sandia National Labs., Albuquerque, NM (United States). Oct 1991. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. Order Number DE93012205. Source: OSTI; NTIS; INIS; GPO Dep.

Core samples are needed for obtaining data on radionuclide retardation. The cores will be used to first determine local basic properties of Culebra rock such as permeability, structural integrity, fracture spacing, and fracture size. These quantities will then be used to design a laboratory experimental program to determine radionuclide retardation in a column flow apparatus using the cores obtained in this project. This addendum covers only the coring activities necessary to retrieve Culebra cores. The laboratory work will be documented in a separate test plan. It is anticipated that Culebra rock samples will be highly fractured, with a fracture spacing on the order of 2 to 3 inches To obtain representative core samples that are intact, horizontal cores about 6 inches in diameter and several feet long will be needed. These cores will provide a good indication of Culebra rock fracturing and provide several samples needed to conduct column flow experiments. If the rock is so fractured that only rubble is obtained, then the rubble will be used

in the column experiments. In addition, as a byproduct of the coring operation, natural groundwater collected from the holes will be used to develop a synthetic brine for the laboratory experiments.

22935 (DOE/DP/00789–T275) **Test plan appendix: WIPP simulated RH TRU waste add-on tests (Additional rock mechanics and waste package performance).** Molecke, M.A.; Munson, D.E. Sandia National Labs., Albuquerque, NM (United States). Aug 1987. 70p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. Order Number DE93012206. Source: OSTI; NTIS; GPO Dep.

Simulated RH TRU waste technology experiments have been subjected to heated-environment operations in WIPP Room T since September 1986, as part of program. The scope of the expanded at this time to address a (radioactive) PH TRU waste storage in the WIPP in "reference" storage roam configurations, or modifications thereto. specifically, more data are needed on the rock mechanics behavior of the RH TRU storage roams and adjacent pillars, closure deformation for both unlined boreholes and sleeved boreholes, and related waste package performance considerations. The data will be applicable to both the initial five-year period of retrievability (using sleeved boreholes) and the post-retrieval period (with unlined boreholes). In situ testing data will also be compared to 3-dimensional computer modeling of rock mechanics behavior. Such data and associated modeling studies obtained and interpreted as early as possible will allow the WIPP project (including operations, scientific support, and performance assessment) to assess the consequences of maximum thermal loading during the pilot phase of operations. Data and testing experience will support the design, emplacement, and retrieval operations, and related concerns associated with these operations. RH TRU data gathered in the nonradioactive test environment of Room T will be useful and timely to the WIPP project and will minimize testing expenses and difficulties.

22936 (DOE/DP/00789–T276) **Test plan: WIPP horizon in situ permeability measurements.** Peterson, E.W. (S-Cubed, La Jolla, CA (United States)); Stormont, J.C. Sandia National Labs., Albuquerque, NM (United States); S-Cubed, La Jolla, CA (United States). Aug 1984. 18p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. Order Number DE93012207. Source: OSTI; NTIS; GPO Dep.

In situ gas permeability tests are to be conducted at the proposed repository horizon at the Waste Isolation Pilot Plant (WIPP) site in southeastern New Mexico. These tests, as well as others, are part of the Plugging and Sealing Program. The tests described in this test plan represent the initial effort to obtain a detailed in situ measure of the flow characteristics of the formation adjacent to the underground workings at the proposed repository site. Measurements will be made in boreholes drilled in the vertically up, vertically down, and horizontal directions. Tests will be performed at various hole depths to obtain data in both the disturbed and free-field regions. These permeability tests will provide data on the repository near-field permeability properties and will aid in identifying future test requirements. In addition, these data may be used as input to various performance assessment analyses and preliminary plug designs.

22937 (DOE/DP/00789–T278) **1986 WIPP horizon permeability measurements.** Stormont, J. Sandia National Labs., Albuquerque, NM (United States). 16 Dec 1985. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. Order Number DE93012209. Source: OSTI; NTIS; GPO Dep.

Addendum to "Test plan: WIPP horizon in situ permeability measurements," E. Peterson and J. Stormont, August 1984.

A series of permeability measurements in the WIPP facility have been planned for fiscal year 1986. These measurements are to be made by S-Cubed and SNL and follow from and supplement previous measurements. These measurements are part of the overall WIPP horizon permeability testing and are justified and described in general terms in the previously published test plan; this paper discusses the technical motivation and test design concepts of these particular measurements.

22938 (DOE/DP/00789–T280) **Test series C of the small scale seal performance tests.** Stormont, J.C. Sandia National Labs., Albuquerque, NM (United States). 30 Sep 1986. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. Order Number DE93012211. Source: OSTI; NTIS; GPO Dep.

Test Series C will evaluate the performance of salt and salt/bentonite block-type seal components. These seal components are essentially a "backfill," but emplaced at a higher density and with more control over the material composition and its installation. These type of seal components are presently being considered as part of the multiple-component drift seals and perhaps as a portion of the shaft seals. The objectives of Test Series C are: 1. To develop and evaluate a technique for the manufacture and installation of block-type seal components; 2. To obtain data on the fluid flow performance of salt and salt/bentonite block-type seal systems; 3. To obtain data on the structural performance of salt and salt/bentonite block-type seal systems; and 4. To provide data for the development and validation of predictive numerical codes and models.

22939 (DOE/DP/00789–T281) **Field operations plan for permeability testing in the WIPP-site underground facility.** Saulnier, G.J. Jr. (Intera Technologies, Inc., Austin, TX (United States)). Sandia National Labs., Albuquerque, NM (United States); Intera Technologies, Inc., Austin, TX (United States). 9 Aug 1988. 46p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. Order Number DE93012212. Source: OSTI; NTIS; GPO Dep.

This Field Operations Plan (FOP) describes the objectives, design, equipment, and methodology for permeability tests to be conducted in boreholes drilled from the underground facility currently under construction at the 655-meter depth level at the Waste Isolation Pilot Plant (WIPP) site in southeastern New Mexico into relatively undisturbed portions of the Salado formation. The WIPP is a U. S. Department of Energy research and development facility designed to demonstrate safe disposal of transuranic radioactive wastes resulting from the United States's defense programs. The testing described in this FOP will be conducted by INTERA Technologies, Inc., under contract to the Earth Sciences Division of Sandia National Laboratories (SNL). The testing program is part of the WIPP-site Hydrogeologic Characterization and Plugging and Sealing programs being conducted by SNL's Earth Sciences and Experimental Programs Divisions, respectively.

22940 (DOE/DP/00789–T285) **Test plan: Intermediate scale borehole test–WIPP in situ testing.** Munson, D.E. Sandia National Labs., Albuquerque, NM (United States). Aug 1989. 66p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. Order Number DE93012216. Source: OSTI; NTIS; INIS; GPO Dep.

This Intermediate Scale Borehole Test is in response to a request by the WIPP Panel of the National Academy of Sciences to investigate influence of scale (i.e., the size of an underground opening) effects on the creep closure of a natural salt deposit, in situ. The purpose of this intermediate scale test is to evaluate the possible influence of test scale on the creep response of salt. The results are to be usedas partial input to the resolution of the discrepancy between calculated and measured in situ closures. The test consists of an instrumented, large diameter, horizontal borehole emplaced in the existing pillar between Rooms C2 and C1. The depth of the core hole will be at least 9.2 m (30 ft). Because most of the instruments will be emplaced prior to drilling of the intermediate scale borehole, the instruments will monitor the changes in ground displacements and stresses as the borehole is drilled.

22941 (DOE/DP/00789–T287) **Test plan: Gas-threshold-pressure testing of the Salado Formation in the WIPP underground facility.** Saulnier, G.J. Jr. (INTERA, Inc., Austin, TX (United States)). Sandia National Labs., Albuquerque, NM (United States); INTERA, Inc., Austin, TX (United States). Mar 1992. 42p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. Order Number DE93012218. Source: OSTI; NTIS; INIS; GPO Dep.

Performance assessment for the disposal of radioactive waste from the United States defense program in the WIPP underground

facility must assess the role of post-closure was generation by waste degradation and the subsequent pressurization of the facility. be assimilated by the host formation will Whether or not the generated gas can be assimilated by the host formation will determine the ability of the gas to reach or exceed lithostatic pressure within the repository. The purpose of this test plan is (1) to present a test design to obtain realistic estimates of gas-threshold pressure for the Salado Formation WIPP underground facility including parts of the formation disturbed by the underground of the Salado, and (2) to provide a excavations and in the far-field or undisturbed part framework for changes and amendments to test objectives, practices, and procedures. Because in situ determinations of gas-threshold pressure in low-permeability media are not standard practice, the methods recommended in this testplan are adapted from permeability-testing and hydrofracture procedures. Therefore, as the gas-threshold-pressure testing program progresses, personnel assigned to the program and outside observers and reviewers will be asked for comments regarding the testing procedures. New and/or improved test procedures will be documented as amendments to this test plan, and subject to similar review procedures.

22942 (DOE/FTR–93012360) **[Travel to Russia to convene a technology exchange workshop at the Khlopin Radium Institute in St. Petersburg in the area of chemical separations or partitioning of elements from radioactive waste streams and to hold the second meeting of the US/Russian Joint Coordinating Committee on Environmental Restoration and Waste Management (JCCEM) with MINATOM senior staff in Moscow]: Foreign trip report, October 29–November 7, 1992.** Bradley, D.J. (Pacific Northwest Lab., Richland, WA (United States)); Frank, C.W.; Fryberger, T.A.; De LaTorre, G.; Solecki, J.E. USDOE, Washington, DC (United States). 6 Dec 1992. 79p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93012360. Source: OSTI; NTIS (US Sales Only); GPO Dep.

A US Department of Energy (DOE) delegation, led by Dr. Clyde Frank, visited Russia from November 1–6, 1992 to conduct a technology exchange workshop at the Khlopin Radium Institute in St. Petersburg in the area of chemical separations or partitioning. This technology is of interest due to the possibility of reducing the amount of radioactive materials, via chemical separation and concentration, that may have to be disposed of. An initial joint US DOE/Khlopin Radium Institute study, completed in September 1992, was reviewed and the final report from this work is attached as Appendix A. Presentations on separations chemistry activities were presented by both US and Russian scientists. A basis for a continuing scope of work for application of Russian separations technology for processing US radioactive wastes was prepared for review. Waste streams in addition to those at Hanford will also be considered.

22943 (DOE/FTR–93012926) **[Travel to the United Kingdom for information exchange on plutonium waste, manufacturing processes, Complex 21 and Rocky Flats programs]: Foreign trip report, March 23–25, 1992.** Rising, T.L. EG and G Rocky Flats, Inc., Golden, CO (United States). Rocky Flats Plant. 16 Jun 1992. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC34-90DP62349. Order Number DE93012926. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The purpose of this trip was to exchange information on plutonium waste, D&D and manufacturing processes and issues for the advancement of Complex 21 and Rocky Flats programs. Additionally, Dr. Rising took a trip up to AEA's (Atomic Energy Authority) Dounreay facility to discuss the practicality of using mediated Electrochemical Oxidation (MEMO) for destruction of organic wastes. While at Dounreay, Dr. Rising toured their operating supercompator facility.

22944 (DOE/FTR–93013558) **[Travel to Mol, Belgium and Karlsruhe, Germany to discuss decommissioning technology and noble metals testing]: Foreign trip report, June 29–July 17, 1992.** Calmus, R.B. (comp.). Westinghouse Hanford Co., Richland, WA (United States). 1992. 51p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE93013558. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Based on discussions between Belgoprocess, the company responsible for conducting the Belgian Radioactive Waste Management Program and Hanford staff, Dr. E. C. Norman of the US Department of Energy, Richland Field Office (RL), and Mr. R. B. Calmus, Westinghouse Hanford Company (WHC), during the subject trip to Mol, Belgium, there is a distinct potential for establishing a decommissioning technology information exchange agreement between US Department of Energy and the Belgian State. It appears that if the PAMELA decommissioning activities are relevant to Hanford activities [specifically Hanford Waste Vitrification Plant (HWVP) melter decommissioning] and, if decommissioning activities at Hanford are of interest to the Belgians, a bilateral technology exchange agreement could be established. Kernforschunqszentrum GmbH ESM Testing. The HWVP noble metals testing being conducted at Kernforschungszentrum GmbH [Karlsruhe Nuclear Research Center, (KfK)] in Karlsruhe, Germany, includes feed preparation and vitrification of five batches of HWVP FY 1991 reference simulant feed (four with noble metals and one without). The first batch scheduled for processing is void of noble metals (NM) and is being tested to provide equipment verification and melter operating parameters information. The remaining batches (4) contain the reference noble metals composition. The noble metals testing is expected to provide important information on noble metals effects on melter, and ancillary equipment, performance and provide input data to the HWVP melter performance assessment activity.

22945 (DOE-HMIP-RR–92.099) **Comparative study of humic and fulvic substances in groundwaters. Pt. 3: Metal complexation with humic substances.** Higgo, J.J.W. (British Geological Survey, Keyworth (United Kingdom). Fluid Processes Research Group); Davis, J.; Smith, B. Department of the Environment, London (United Kingdom). Her Majesty's Inspectorate of Pollution. 1992. [75p.] Contract PECD-7/9/533;WE/92/12. Order Number DE93626424. Source: OSTI; NTIS (US Sales Only); INIS.

Humic and fulvic acids were extracted from large volumes of three different groundwaters. After purification they were characterised in terms of proton-binding properties, molecular weight, UV spectra and trace impurities. Conditional stability constants were measured for fulvic and humic binding with cobalt, nickel, calcium and uranium. From these, intrinsic binding constants were calculated using Humic Ion-Binding Model V which was found to describe the dependence of binding strength on pH and ionic strength reasonably well. Species distributions in the groundwaters were calculated and the effects of competition with alkali earths are discussed. All the experimental data are reported in a separate volume (Appendix A and B) so that they are available for testing other models. (author).

22946 (DOE-HMIP-RR–92.118) **Procedures for the elicitation of expert judgements in the probabilistic risk analysis of radioactive waste repositories: an overview.** Watson, S.R. Department of the Environment, London (United Kingdom). Her Majesty's Inspectorate of Pollution. 1992. [36p.] Contract PECD-7/9/637. Order Number DE93626425. Source: OSTI; NTIS (US Sales Only); INIS.

In modelling the consequences of a radioactive waste repository using Probabilistic Risk Analysis, it is necessary to use the judgement of experts both in assessing probabilities subjectively, and in choosing suitable analytic frameworks. This report presents the literature on these topics, first discussing the meaning of probability in PRA, and then giving an extensive review of what is known about how to elicit probabilities from experts. The report then provides an overview of the less well developed field of how best to use expertise in the construction of models for PRA. (author).

22947 (DOE/ID–10415) **Waste handling plan for the INEL Oversight Program (As required under the Waste Handling Memorandum of Agreement).** EG and G Idaho, Inc., Idaho Falls, ID (United States). Feb 1993. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-76ID01570. (INEL/MISC–93014). Order Number DE93012171. Source: OSTI; NTIS; INIS; GPO Dep.

The State of Idaho will generate various quantities and types of waste during monitoring activities associated with the Idaho National Engineering Laboratory (INEL) Oversight Program. This waste, referred to as INEL Oversight Program (IOP) waste, is the

waste resulting from field season activities of the IOP. Wastes generated at the INEL are broadly categorized by the types of contaminants they contain. These include: hazardous waste; high-level waste; low-level waste; mixed waste; sanitary waste; and transuranic waste. To the extent possible, generation of allowable MOA (Waste Handling Memorandum of Agreement) wastes should be minimized. Minimization of waste includes waste prevention, reduction of waste components, and recycling. The following are some general waste minimization techniques which pertain to current monitoring activities such as purging and sampling existing monitoring wells and associated activities. Regulations affecting the management of IOP can differ depending upon the site designation of the waste generation point. Possible site designations at the INEL include: non-regulated sites; comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) sites; sites regulated under the authority of RCRA; and newly discovered contaminated sites. (AT)

22948 (DOE/LLW–162) **Management plan for revision for DOE Order 5820.2A: National Low-Level Waste Management Program.** Kudera, D.E.; McMurtrey, C.D. EG and G Idaho, Inc., Idaho Falls, ID (United States). Feb 1993. 20p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-76ID01570. (INEL/MISC–92154). Order Number DE93012170. Source: OSTI; NTIS; GPO Dep.

This document discusses how the US Department of Energy (DOE) will manage the revision of DOE Order 5820.2A, "Radioactive Waste Management," and describes personnel involved in the effort, estimated cost and schedule, and administrative and reporting requirements. The organizational structure and responsibilities and approval authorities for the revision are discussed. A planning package is included that provides details on the schedule, budget, and justification and assumptions used in developing the plan for revision.

22949 (DOE/LLW–166) **Sealed source and device removal and consolidation feasibility study: National Low-Level Waste Management Program.** Ward, J.E. (Pacific Northwest Lab., Richland, WA (United States)); Carter, J.G.; Meyers, R.L. EG and G Idaho, Inc., Idaho Falls, ID (United States); Pacific Northwest Lab., Richland, WA (United States). Feb 1993. 109p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-76ID01570. Order Number DE93013696. Source: OSTI; NTIS; INIS; GPO Dep.

The purpose of this study is to assess the feasibility of removing Greater-Than-Class C (GTCC) sealed sources from their containment device and consolidating them for transport to a storage or disposal facility. A sealed source is a sealed capsule containing a radioactive material that is placed in a device providing radioactive containment. It is used in the medical, industrial, research, and food-processing communities for calibrating, measuring, gauging, controlling processes, and testing. This feasibility study addresses the key operational, safety, regulatory, and financial requirements of the removal/consolidation process. This report discusses the process to receive, handle, repackage, and ship these sources to an interim or dedicated storage facility until a final disposal repository can be built and become operational (~ c. 2010). The study identifies operational and facility requirements to perform this work. Hanford, other DOE facilities, and private hot-cell facilities were evaluated to determine which facilities could perform this work. The personnel needed, design and engineering, facility preparation, process waste disposal requirements, and regulatory compliance were evaluated to determine the cost to perform this work. Cost requirements for items that will have to meet future changing regulatory requirements for transportation, transportation container design and engineering, and disposal were not included in this study. The cost associated with in-process consolidation of the sealed sources reported in this study may have not been modified for inflation and were based on 1992 dollars. This study shows that sealed source consolidation is possible with minimal personnel exposure, and would reduce the risk of radioactive releases to the environment. An initial pilot-scale operation could evaluate the possible methods to reduce the cost and consolidate sources.

22950 (DOE/LLW–172) **Greater-than-Class C Low-Level Radioactive Waste Program 1992 baseline strategy.** EG and G Idaho, Inc., Idaho Falls, ID (United States). Feb 1993. 35p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-76ID01570. Order Number DE93013738. Source: OSTI; NTIS; INIS; GPO Dep.

This baseline strategy document describes Department of Energy (DOE) goals, objectives, and strategy for fulfilling its responsibility to dispose of greater-than-Class C low-level radioactive waste (GTCC LLW) according to the requirements of Section 3(b) of the Low-Level Radioactive Waste Policy Amendments Act of 1985, Public Law 99-240. This document describes the baseline strategy being employed at the end of FY 1992. The strategy for fulfilling the above responsibility consists of three tasks: interim storage of limited quantities of GTCC LLW at a currently operating DOE facility to eliminate a potential public health and safety threat; acceptance of GTCC LLW for storage in a DOE dedicated facility on an as-needed basis pending disposal; and disposal in a facility licensed by the Nuclear Regulatory Commission. The objectives, assumptions, and strategies for each of these tasks are presented in this plan.

22951 (DOE/NV/10872–8) **Identification and characterization of conservative organic tracers for use as hydrologic tracers for the Yucca Mountain Site Characterization Project: Quality Assurance Project Plan: Quarterly technical progress report, January 1, 1993–March 31, 1993.** Stetzenbach, K.J. Nevada Univ., Las Vegas, NV (United States). Harry Reid Center for Environmental Studies. 25 Feb 1993. 70p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC08-90NV10872. Order Number DE93014228. Source: OSTI; NTIS; INIS; GPO Dep.

Studies continued on organic tracers for use as hydrologic tracers as part of the Yucca Mountain Site Characterization project. This subject report for the quarter 01/01/93 through 03/31/93 discusses the following issues: project organization and responsibilities; quality assurance program; design control; procurement document control; instructions, procedures, and drawings; document control; control of purchased items and services; identification and control of items; control of processes; inspection; test control; control of measuring and test equipment; handling, storage, and shipping; inspection, test, and operating status; control of nonconforming items and conditions; corrective action; quality assurance records; audits; software quality assurance; and scientific investigation.

22952 (DOE/NV/10872–T55) **Quarterly progress report on the Waste Package Project at the University of Nevada, Las Vegas, January 1, 1993–March 31, 1993.** Ladkany, S.G. Nevada Univ., Las Vegas, NV (United States). 1993. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC08-90NV10872. Order Number DE93014241. Source: OSTI; NTIS; GPO Dep.

Accomplishments for the past quarter are briefly described for: task A.2.1 on criticality studies and drift emplacement model; and for task A.2.2. on waste container alternate design considerations.

22953 (DOE/OR–01-1100-D3) **RCRA Closure Plan for the Bear Creek Burial Grounds B Area and Walk-In Pits at the Oak Ridge Y-12 Plant, Oak Ridge, Tennessee: Energy Systems Environmental Restoration Program; Y-12 Environmental Restoration Program.** Oak Ridge Y-12 Plant, TN (United States). Apr 1993. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OS21400. (Y/ER–53-D3). Order Number DE93013251. Source: OSTI; NTIS; INIS; GPO Dep.

In June 1987, the RCRA Closure/Postclosure Plan for the Bear Creek Burial Grounds (BCBG) was submitted to the Tennessee Department of Environment and Conservation (TDEC) for review and approval. TDEC modified and issued the plan approved on September 30, 1987. Y/TS-395 was initially intended to apply to A Area, C-West, B Area, and the Walk-In Pits of BCBG. However, a concept was developed to include the B Area (non-RCRA regulated) in the Walk-In Pits so that both areas would be closed under one cap. This approach included a tremendous amount of site preparation with an underlying stabilization base of 16 ft of sand for blast protection. In January 1993, the Closure Plan was revised to include inspection and maintenance criteria and to reflect that future monitoring and remediation would be conducted as part of

the ongoing Comprehensive Environmental Response, Compensation, and Liability Act activities at the Oak Ridge Y-12 Plant. This Closure Plan revision is intended to reflect the placement of the Kerr Hollow Quarry debris at the Walk-In Pits, revise the closure dates, and acknowledge that the disposition of a monitoring well within the closure site cannot be verified.

22954 (DOE-RAS–92.003) **Induced polarisation and the assessment of sorption/diffusion at radioactive waste repository sites: Final report.** Bouda, S. (Exeter Univ. (United Kingdom). Earth Resources Centre); Durrance, E.M.; Grainger, P. Department of the Environment, London (United Kingdom). Radioactive Substances Div. 1992. [75p.] Contract PECD-7/9/442. (ERC–91-22.). Order Number DE93626426. Source: OSTI; NTIS (US Sales Only); INIS.

Induced polarisation is a geophysical technique used in mineral exploration in search of metallic ore deposits. Clay minerals also polarise when subjected to an electric current, although the mechanism differs from that of metallic bodies, and involves, amongst other properties, the clay mineral species, the interlayer spacing of the clay, and the nature and abundance of mobile ions in the pore fluid. As a result, it was proposed that induced polarisation of clays could be used as a method for determining their permeability and diffusivity. The work carried out in developing experimental procedures, and evaluating the feasibility of the proposal is presented in this report. (author).

22955 (DOE/RL–91-39-Rev.1A) **Waste water pilot plant research, development, and demonstration permit application: Revision 1A.** USDOE Richland Field Office, WA (United States). Mar 1993. 295p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE93012618. Source: OSTI; NTIS; INIS; GPO Dep.

This permit application has been prepared to obtain a research, development, and demonstration permit to perform pilot-scale treatability testing on the 242-A Evaporator process condensate waste water effluent stream. It provides the management framework, and controls all the testing conducted in the waste water pilot plant using dangerous waste. It also provides a waste acceptance envelope (upper limits for selected constituents) and details the safety and environmental protection requirements for waste water pilot plant testing. This permit application describes the overall approach to testing and the various components or requirements that are common to all tests. This permit application has been prepared at a sufficient level of detail to establish permit conditions for all waste water pilot plant tests to be conducted.

22956 (DOE/RL–92-51) **100 Area soil washing treatability test plan.** USDOE Richland Field Office, WA (United States). Mar 1993. 58p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93012617. Source: OSTI; NTIS; INIS; GPO Dep.

This test plan describes specifications, responsibilities, and general methodology for conducting a soil washing treatability study as applied to source unit contamination in the 100 Area. The objective ofthis treatability study is to evaluate the use of physical separation systems and chemical extraction methods as a means of separating chemically and radioactively contaminated soil fractions from uncontaminated soil fractions. The purpose of separating these fractions is to minimize the volume of soil requiring permanent disposal. It is anticipated that this treatability study will be performed in two phases of testing, a remedy screening phase and a remedy selection phase. The remedy screening phase consists of laboratory- and bench-scale studies performed by Battelle Pacific Northwest laboratories (PNL) under a work order issued by Westinghouse Hanford Company (Westinghouse Hanford). This phase will be used to provide qualitative evaluation of the potential effectiveness of the soil washing technology. The remedy selection phase, consists of pilot-scale testing performed under a separate service contract to be competitively bid under Westinghouse Hanford direction. The remedy selection phase will provide data to support evaluation of the soil washing technology in future feasibility studies for Interim Remedial Measures (IRMs) or final operable unit (OU) remedies. Performance data from these tests will indicate whether applicable or relevant and appropriate requirements (ARARs) or cleanup goals can be met at the site(s) by application of soil washing. The remedy selection tests wig also allow estimation of costs associated with implementation to the accuracy required for the Feasibility Study.

22957 (DOE/RW–0345P) **DOE's Yucca Mountain studies.** USDOE Office of Civilian Radioactive Waste Management, Washington, DC (United States). Education and Information Div.; USDOE Yucca Mountain Site Characterization Project Office, Las Vegas, NV (United States). Dec 1992. 21p Sponsored by USDOE, Washington, DC (United States). Source: OSTI (Free of Charge); INIS.

This booklet is about the disposal of high-level nuclear waste in the United States. It is for readers who have a general rather than a technical background. It discusses why scientists and engineers thinkhigh-level nuclear waste may be disposed of safely underground. It also describes why Yucca Mountain, Nevada, is being studied as a potential repository site and provides basic information about those studies

22958 (DOE/RW–0410) **Program Baseline Change Control Board charter.** USDOE Office of Civilian Radioactive Waste Management, Washington, DC (United States). Feb 1993. 7p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93012192. Source: OSTI; NTIS; INIS; GPO Dep.

The purpose of this Charter is to establish the Program Baseline Change Control Board (PBCCB) for the Office of Civilian Radioactive Waste Management (OCRWM) Program, and to describe its organization, responsibilities, and basic methods of operation. Guidance for implementing this Charter is provided by the OCRWM Baseline Management Plan (BMP) and OCRWM Program Baseline Change Control Procedure.

22959 (DOE/RW–0411) **Technical career opportunities in high-level radioactive waste management.** USDOE Office of Civilian Radioactive Waste Management, Washington, DC (United States). 1993. 15p. Sponsored by USDOE, Washington, DC (United States). Source: OSTI (Free of Charge); INIS.

Technical career opportunities in high-level radioactive waste management are briefly described in the areas of: Hydrology; geology; biological sciences; mathematics; engineering; heavy equipment operation; and skilled labor and crafts.

22960 (DOE/RW–0416) **OCRWM baseline management procedure for document identifiers.** USDOE Office of Civilian Radioactive Waste Management, Washington, DC (United States). Mar 1993. 22p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93013733. Source: OSTI; NTIS; INIS; GPO Dep.

This procedure establishes a uniform numbering system (document identifier) for all Program and project technical, cost, and schedule baselines, and selected management and procurement documents developed for and controlled by the Office of Civilian Radioactive Waste Management (OCRWM) for the Civilian Radioactive Waste Management System (CRWMS). The document identifier defined in this procedure is structured to ensure that the relational integrity between configuration items (CIs) and their associated documentation and software is maintained, traceable, categorical, and retrievable for the life of the program.

22961 (DOE/WIPP–89-011-Rev.1) **Test phase plan for the Waste Isolation Pilot Plant: Revision 1.** USDOE Albuquerque Field Office, NM (United States). Waste Isolation Pilot Plant Project Integration Office; Sandia National Labs., Albuquerque, NM (United States). Mar 1993. 235p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. Order Number DE93012198. Source: OSTI; NTIS; INIS; GPO Dep.

The US Department of Energy (DOE) has prepared this Test Phase Plan for the Waste Isolation Pilot Plant to satisfy the requirements of Public Law 102-579, the Waste Isolation Pilot Plant (WIPP) Land Withdrawal Act (LWA). The Act provides seven months after its enactment for the DOE to submit this Plan to the Environmental Protection Agency (EPA) for review. A potential geologic repository for transuranic wastes, including transuranic mixed wastes, generated in national-defense activities, the WIPP is being constructed in southeastern New Mexico. Because these wastes remain radioactive and chemically hazardous for a very long time, the WIPP must provide safe disposal for thousands of years. The

DOE is developing the facility in phases. Surface facilities for receiving waste have been built and considerable underground excavations (2150 feet below the surface) that are appropriate for in-situ testing, have been completed. Additional excavations will be completed when they are required for waste disposal. The next step is to conduct a test phase. The purpose of the test phase is to develop pertinent information and assess whether the disposal of transuranic waste and transuranic mixed waste in the planned WIPP repository can be conducted in compliance with the environmental standards for disposal and with the Solid Waste Disposal Act (SWDA) (as amended by RCRA, 42 USC. 6901 et. seq.). The test phase includes laboratory experiments and underground tests using contact-handled transuranic waste. Waste-related tests at WIPP will be limited to contact-handled transuranic and simulated wastes since the LWA prohibits the transport to or emplacement of remote-handled transuranic waste at WIPP during the test phase.

22962 (DOE/WIPP–89-022-Rev.1) **Waste retrieval plan for the Waste Isolation Pilot Plant: Revision 1.** USDOE Albuquerque Operations Office, Carlsbad, NM (United States). Waste Isolation Pilot Plant Project Office; Sandia National Labs., Albuquerque, NM (United States). Mar 1993. 103p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. Order Number DE93012197. Source: OSTI; NTIS; INIS; GPO Dep.

The US DOE has prepared this plan to meet the requirements of Public Law 102579, the Waste Isolation Pilot Plant (WIPP) LWA, The purpose. is to demonstrate readiness to retrieve from the WIPP underground transuranic radioactive waste that will be used for testing should retrieval be needed. The WIPP, a potential geologic repository for transuranic wastes generated in national-defense activities, has been constructed in southeastern New Mexico. Because the transuranic wastes will remain radioactive for a very long time, the WIPP must reasonably ensure safe performance over thousands of years. The DOE therefore decided to develop the facility in phases, to preclude premature decisions and to conduct the performance assessments needed to demonstrate long-term safety. Surface facilities for receiving waste have been built, and considerable underground excavation, 2150 feet below the surface, has been completed. The next step is a test phase, including underground experiments called "bin tests" and "alcove test(s)" with contact-handled transuranic waste. The objective of these waste tests is to collect relevant data about the gas-generation potential and volatile organic compound (VOC) source term of the waste for developing a basis for demonstrating long term safety by compliance with the applicable disposal regulations (40 CFR 191, 264 and 268). The test phase will end when a decision is made to begin disposal in the WIPP or to terminate the project if regulatory compliance cannot be determined and demonstrated. Authorization to receive transuranic waste at the WIPP for the test phase is given by the WIPP LWA provided certain requirements are met.

22963 (DPSTSA–200-10-Suppl.-18-Del.Ver.) **Safety analysis, 200 Area, Savannah River Plant separations area operations: Liquid radioactive waste handling facilities: Supplement 18.** Legler, B.M.; McDonell, W.R.; Perkins, W.C.; Stephenson, A.T. Du Pont de Nemours (E.I.) and Co., Aiken, SC (United States). Savannah River Lab. Aug 1988. 582p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001 ;AC09-89SR18035. Order Number DE93009745. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report documents operations at the Savannah River Plant's 200 Area. Topics discussed include liquid radioactive waste handling, storage tanks, and meteorology at the Savannah River Plant. A glossary and tank inventories are included also.

22964 (DPW–3637) **Notes on meeting of Waste Processing Committee.** Winsche, W.E. Du Pont de Nemours (E.I.) and Co., Wilmington, DE (United States). Explosives Dept. 29 Oct 1951. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. (SR/H–465). Order Number DE93011160. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The purpose of this memorandum is to summarize an October, 1951 meeting of the duPont Waste Processing Committee for internal use prior to issue of formal minutes.

22965 (DPW–4300) **Solid waste disposal.** Purdie, O.D. Du Pont de Nemours (E.I.) and Co., Wilmington, DE (United States). Atomic Energy Div. 10 Jan 1952. 2p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. (SR/H–459). Order Number DE93011154. Source: OSTI; NTIS (US Sales Only); GPO Dep.

In this January 1952 memo, from Otis Purdie, outlines possible alternatives for handling solid combustible wastes at the Savannah River site. Three alternatives were considered. These were incineration, baling, and storage without processing. After a cost analysis, it was decided that incineration was undesirable and that there were uncertainties in the baling process. It was recommended that storage without processing be adopted, at least for plant startup. The method of waste storage was still under discussion.

22966 (EGG-LLW–9525) **Commercial radioactive waste minimization program development guidance.** Fischer, D.K. EG and G Idaho, Inc., Idaho Falls, ID (United States). Jan 1991. 29p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-76ID01570. Order Number DE93011395. Source: OSTI; NTIS; INIS; GPO Dep.

This document is one of two prepared by the EG&G Idaho, Inc., Waste Management Technical Support Program Group, National Low-Level Waste Management Program Unit. One of several Department of Energy responsibilities stated in the Amendments Act of 1985 is to provide technical assistance to compact regions Host States, and nonmember States (to the extent provided in appropriations acts) in establishing waste minimization program plans. Technical assistance includes, among other things, the development of technical guidelines for volume reduction options. Pursuant to this defined responsibility, the Department of Energy (through EG&G Idaho, Inc.) has prepared this report, which includes guidance on defining a program, State/compact commission participation, and waste minimization program plans.

22967 (EGG-WM–9185-Rev.1) **Waste minimization for commercial radioactive materials users generating low-level radioactive waste: Revision 1.** Fischer, D.K. (EG and G Idaho, Inc., Idaho Falls, ID (United States)); Gitt, M.; Williams, G.A.; Branch, S.; Otis, M.D.; McKenzie-Carter, M.A.; Schurman, D.L. EG and G Idaho, Inc., Idaho Falls, ID (United States); Science Applications International Corp., Idaho Falls, ID (United States). Jul 1991. 62p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-76ID01570. Order Number DE93011396. Source: OSTI; NTIS; INIS; GPO Dep.

The objective of this document is to provide a resource for all states and compact regions interested in promoting the minimization of low-level radioactive waste (LLW). This project was initiated by the Commonwealth of Massachusetts, and Massachusetts waste streams have been used as examples; however, the methods of analysis presented here are applicable to similar waste streams generated elsewhere. This document is a guide for states/compact regions to use in developing a system to evaluate and prioritize various waste minimization techniques in order to encourage individual radioactive materials users (LLW generators) to consider these techniques in their own independent evaluations. This review discusses the application of specific waste minimization techniques to waste streams characteristic of three categories of radioactive materials users: (1) industrial operations using radioactive materials in the manufacture of commercial products, (2) health care institutions, including hospitals and clinics, and (3) educational and research institutions. Massachusetts waste stream characterization data from key radioactive materials users in each category are used to illustrate the applicability of various minimization techniques. The utility group is not included because extensive information specific to this category of LLW generators is available in the literature.

22968 (EGG-WM–10533) **Treatability study for the bench-scale solidification of nonincinerable LDR low-level mixed waste.** Gering, K.L. EG and G Idaho, Inc., Idaho Falls, ID (United States). Jan 1993. 106p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-76ID01570. Order Number DE93012189. Source: OSTI; NTIS; INIS; GPO Dep.

The focus of this report is the solidification of nonincinerable, land disposal restricted (LDR) low-level mixed waste generated at

the Idaho National Engineering Laboratory. Benchscale solidification was performed on samples of this mixed waste, which was done under a Resource Conservation and Recovery Act treatability study. Waste forms included liquids, sludges, and solids, and treatment techniques included the use of conventional Portland cement and sulphur polymer cement (SPC). A total of 113 monoliths were made under the experimental design matrix for this study; 8 of these were "blank" monoliths (contained no waste). Thus, 105 monoliths were used to solidify 21.6 kg of mixed waste; 92 were made with Portland cement systems, and 13 were made with SPC. Recipes for all monoliths are given, and suggested recipes (as based on the minimized leaching of toxic components) are summarized. In most cases, the results presented herein indicate that solidification was successful in immobilizing toxic metals, thereby transforming low-level mixed waste into low-level nonhazardous waste. The ultimate goal of this project is to use appropriate solidification techniques, as described in the literature, to transform low-level mixed waste to low-level nonhazardous waste by satisfying pertinent disposal requirements for this waste. Disposal requirements consider the toxicity characteristic leaching procedure tests, a free liquids test, and radiological analyses. This work is meaningful in that it will provide a basis for the disposal of waste that is currently categorized as LDR low-level mixed waste.

22969 (EGG-WM–10630) **Processing results of 1,800 gallons of mercury and radioactively contaminated mixed waste rinse solution.** Thiesen, B.P. EG and G Idaho, Inc., Idaho Falls, ID (United States). Jan 1993. 147p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-76ID01570. Order Number DE93012166. Source: OSTI; NTIS; INIS; GPO Dep.

The mercury-contaminated rinse solution (INEL waste ID# 123; File 8 waste) was successfully treated at the Idaho National Engineering Laboratory (INEL). This waste was generated during the decontamination of the Heat Transfer Reactor Experiment 3 (HTRE-3) reactor shield tank. Approximately 1,800 gal of waste was generated and was placed into 33 drums. Each drum contained precipitated sludge material ranging from 1–10 in. in depth, with the average depth of about 2.5 in. The pH of each drum varied from 3–11. The bulk liquid waste had a mercury level of 7.0 mg/l, which exceeded the Resource Conservation and Recovery Act (RCRA) limit of 0.2 mg/l. The average liquid bulk radioactivity was about 2.1 pCi/ml, while the average sludge contamination was about 13,800 pci/g. Treatment of the waste required separation of the liquid from the sludge, filtration, pH adjustment, and ion exchange. Because of difficulties in processing, three trials were required to reduce the mercury levels to below the RCRA limit. In the first trial, insufficient filtration of the waste allowed solid particulate produced during pH adjustment to enter into the ion exchange columns and ultimately the waste storage tank. In the second trial, the waste was filtered down to 0.1 μ to remove all solid mercury compounds. However, before filtration could take place, a solid mercury complex dissolved and mercury levels exceeded the RCRA limit after filtration. In the third trial, the waste was filtered through 0.3-A filters and then passed through the S-920 resin to remove the dissolved mercury. The resulting solut

22970 (EGG-WTD–10539) **Buried Waste Integrated Demonstration FY-93 Deployment Plan.** Bonnenberg, R.W.; Heard, R.E.; Milam, L.M.; Watson, L.R. EG and G Idaho, Inc., Idaho Falls, ID (United States). Feb 1993. 68p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-76ID01570. Order Number DE93012167. Source: OSTI; NTIS; INIS; GPO Dep.

The Buried Waste Integrated Demonstration (BWID) is a program funded by the US Department of Energy Office of Technology Development. BWID supports the applied research, development, demonstration, and evaluation of a suite of advanced technologies that together form a comprehensive remediation system for the effective and efficient remediation of buried waste. The fiscal year 1993 effort will deploy seven major field demonstrations at the Idaho National Engineering Laboratory's (INEL's) Radioactive Waste Management Complex Cold Test Pit. These major demonstrations are Remote Characterization System, Remote Excavation System, Overburden Removal, Waste Isolation, Contamination Control Unit, Rapid Monitoring Unit, and Fixation of Soil Surface Contamination. This document is the basic operational planning document for BWID deployment of the INEL field demonstrations. Additional sections deal briefly with four nonINEL field and laboratory demonstrations (Buried Waste Retrieval, Arc Melter Vitrification, Graphite DC Plasma Arc Melter, and Fixed Hearth Plasma Process) and with four INEL laboratory demonstrations (Electrostatic Curtain, Thermal Kinetics, Multiaxis Crane Control System, and Dig-Face Characterization).

22971 (EGG-WTD–10610) **Buried Waste Integrated Demonstration Strategy Plan.** Kostelnik, K.M. EG and G Idaho, Inc., Idaho Falls, ID (United States). Feb 1993. 48p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-76ID01570. Order Number DE93012188. Source: OSTI; NTIS; INIS; GPO Dep.

The Buried Waste Integrated Demonstration (BWID) supports the applied research, development, demonstration, and evaluation of a suite of advanced technologies that form a comprehensive remediation system for the effective and efficient remediation of buried waste. These efforts are identified and coordinated in support of the US Department of Energy (DOE), Environmental Restoration and Waste Management (ERWM) needs and objectives. The present focus of BWID is to support retrieval and ex situ treatment configuration options. Future activities will explore and support containment and stabilization efforts in addition to the retrieval/ex situ treatment options. Long and short term strategies of the BWID are provided. Processes for identifying technological needs, screening candidate technologies for BWID applicability, researching technical issues, field demonstrating technologies, evaluating demonstration results to determine each technology's threshold of capability, and commercializing successfully demonstrated technologies for implementation for environmental restoration also are presented in this report.

22972 (EGG-WTD–10612) **Buried waste integrated demonstration fiscal year 1992 close-out report.** Cannon, P.G.; Kostelnik, K.M.; Owens, K.J. EG and G Idaho, Inc., Idaho Falls, ID (United States). Feb 1993. 45p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-76ID01570. Order Number DE93012182. Source: OSTI; NTIS; INIS; GPO Dep.

The mission of the Buried Waste Integrated Demonstration Program (BWID) is to support the development and demonstration of a suite of technologies that when integrated with commercially-available baseline technologies form a comprehensive remediation system for the effective and efficient remediation of buried waste disposed of throughout the US Department of Energy complex. To accomplish this mission of identifying technological solutions for remediation deficiencies, the Office of Technology Development initiated the BWID at the Idaho National Engineering Laboratory in fiscal year (FY)-91. This report summarizes the activities of the BWID Program during FY-92.

22973 (EGG-WTD–10674) **Supercritical waste oxidation pump investigation.** Thurston, G.; Garcia, K. EG and G Idaho, Inc., Idaho Falls, ID (United States). Feb 1993. 33p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-76ID01570. Order Number DE93012184. Source: OSTI; NTIS; INIS; GPO Dep.

This report investigates the pumping techniques and pumping equipment that would be appropriate for a 5,000 gallon per day supercritical water oxidation waste disposal facility. The pumps must boost water, waste, and additives from atmospheric pressure to approximately 27.6 MPa (4,000 psia). The required flow ranges from 10 gpm to less than 0.1 gpm. For the higher flows, many commercial piston pumps are available. These pumps have packing and check-valves that will require periodic maintenance; probably at 2 to 6 month intervals. Several commercial diaphragm pumps were also discovered that could pump the higher flow rates. Diaphragm pumps have the advantage of not requiring dynamic seals. For the lower flows associated with the waste and additive materials, commercial diaphragm pumps. are available. Difficult to pump materials that are sticky, radioactive, or contain solids, could be injected with an accumulator using an inert gas as the driving mechanism. The information presented in this report serves as a spring board for trade studies and the development of equipment specifications.

22974 (ES/ER/TM–60) **Environmental Restoration Program pollution prevention performance measures for FY 1993 and 1994 remedial investigations: Generator training manual.** Oak Ridge National Lab., TN (United States); Weston (Roy F.), Inc., Oak Ridge, TN (United States). Mar 1993. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93010559. Source: OSTI; NTIS; INIS; GPO Dep.

This computer-based program is designed to help waste generators in the Environmental Restoration (ER) Program prevent pollution at the DOE Oak Ridge Field Office (DOE-OR) facilities in Oak Ridge, Paducah, and Portsmouth. The Numerical Scoring System (NSS) is an interactive system designed to maintain data on ER Program pollution prevention efforts and to measure the success of these efforts through the ER Program life cycle.

22975 (EUR–14366) **Immobilization of tritium enriched waste water from reprocessing by solidification as zirconium hydride.** Riedel, H.J. (Forschungszentrum Juelich GmbH (Germany)); Ullrich, W. Commission of the European Communities, Luxembourg (Luxembourg). 1993. [173p.] (In German). Vertrag FI 1W0139D (B). Source: OSTI; NTIS (US Sales Only); INIS.

The different streams of waste water which are expected to arise from the operation of the Wackersdorf reprocessing plant were identified as well as their chemical and radiochemical composition. Before the enrichment of tritium by catalytic chemical exchange and electrolysis the remaining contaminations in the waste water must be removed by distillation. In the case of ^{131}I and ^{137}Cs, decontamination factors of 200-350 could be achieved. Other contaminations in the distillate were no longer detectable. An electrolyzer operating with a Solid Polymer Electrolyte, after a loading with 4×10^{-5} g of ions could no longer be operated. Comparative experiments were carried out with a TELEDYNE hydrogen generator HG-501. This device requires 35% KOH as the electrolyte solution. There is neither ^{131}I nor ^{137}Cs in the generated hydrogen - and oxygen - flow detectable. Up to 99% of the ^{131}I is fixed at the electrolytic cell. The operating life of the electrolytic cell is estimated to approx. 10 years, it therefore appears to be a suitable device if modified for operation with radioactive solutions containing tritium. Experiments on zirconium hydride formation served the purpose of determining suitable parameters for a trouble-free loading of zirconium sponge with tritium. Experimental results lead us to the proposal of a new concept for the formation of ZrHT and its final disposal. Batches of 100 g of zirconium sponge are hydrogenated. The HT gas can be directly fixed in batches of 22 litres. Accumulation and storage of the approx. 10 m^3 of HT gas is thus dispensed with. Since fairly small quantities of tritium and protium (180 Ci of tritium in 22 litres of HT gas) are handled per charge the accident potential is low. There is no need for a large-scale facility for handling and fixing HT which is only operated sporadically.

22976 (EUR–14466) **Decontamination of alpha-bearing solid wastes and plutonium recovery.** Koehly, G. (CEA Centre d'Etudes de Fontenay-aux-Roses, 92 (France)); Madic, C.; Lecomte, M.; Bourges, J.; Saulze, J.L.; Broudic, J.C. Commission of the European Communities, Luxembourg (Luxembourg). 1993. [199p.] (In French). Contract FI1W/0013. Source: OSTI; NTIS (US Sales Only); INIS.

Nuclear activities in the Radiochemistry building of Fontenay-aux-Roses Nuclear Research Center concern principally the study of fuel reprocessing and the production of transuranium isotopes. During these activities solid wastes are produced. In order to improve the management of these wastes, it has been decided to build new facilities: a group of three glove-boxes named ELISE for the treatment of α active solid waste and a hot-cell, PROLIXE, for the treatment of solid wastes. Leaching processes were developed in order to: decontaminate these wastes and recover actinide elements, particularly the highly valuable plutonium, from the leachates. The processes developed are sufficiently flexible to be able to accommodate solid wastes produced in other facilities. Laboratory studies were conducted to develop the leaching process based on the use of electrogenerated Ag(II) species which is particularly suitable to provoke the dissolution of PuO_2. Successful exhaustive Pu decontaminations with DF(Pu) higher than 10^4 were achieved for the first time during the treatment of stainless steel PuO_2 cans (future MELOX plant) by electrogenerated Ag (II) in nitric acid medium.

22977 (GSF–23/90) **Further development of the methodical instruments to calculate ground water movements at repository sites.** Arens, G. (GSF - Forschungszentrum fuer Umwelt und Gesundheit GmbH, Braunschweig (Germany). Inst. fuer Tieflagerung); Clauser, C.; Fein, E.; Karpinski, P.; Storck, R. GSF - Forschungszentrum fuer Umwelt und Gesundheit GmbH, Neuherberg (Germany); Bundesministerium fuer Forschung und Technologie, Bonn (Germany). Jun 1990. 114p. (In German). Contract BMFT KWA 5408. (GSF-TL–14/90). Order Number DE93792549. Source: OSTI; NTIS (US Sales Only); INIS.

In addition to the subsequent requirements concerning the Konrad plan approval procedure, other ground water and propagation calculations were also made. All available programs were used. Simple one- and two-dimensional models were considered for which an analytical solution exists. In some cases such analytical solutions are only approximate under certain conditions. By calculating such simple problems, the programs used were tested and verified, and the use of those programs was reviewed and documented. In addition to the finite-difference program SWIFT and the finite-element program CFEST, two other ground water and propagation programs were applied: (1) Finite-difference program MOL, two-dimensional propagation program for ground water flow; (2) SUTRA, two-dimensional hybrid finite-element and integrated finite-difference model for ground water flow and radionuclide migration. (orig./HP).

22978 (IAEA-TECDOC–693, pp. 21-22) **United States national program on Actinide Recycle: Summary.** Khalil, H. (Argonne National Lab., IL (United States)). International Atomic Energy Agency, Vienna (Austria). Mar 1993. (CONF-9209224–: Specialists' meeting on use of fast breeder reactors for actinide transmutation, Obninsk (Russian Federation), 22-24 Sep 1992). In *Use of fast reactors for actinide transmutation: Proceedings of a specialists meeting held in Obninsk, Russian Federation, 22-24 September 1992.* [126p.] Order Number DE93623762. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. ACTINIDES/transmutation; HIGH-LEVEL RADIOACTIVE WASTES/transmutation; TRANSMUTATION/research reactors; TRANSMUTATION/usa; ACTINIDE BURNER REACTORS; ACTINIDES; TRANSMUTATION; LIQUID METAL COOLED REACTORS; MINIMIZATION; RADIOACTIVE WASTE PROCESSING; RECYCLING; USA

22979 (INIS-mf–13518, pp. Z24) **Current state of waste disposal in the Straz pod Ralskem region.** Hrbova, Z. (DIAMO, o.z. Ekologie, Straz pod Ralskem (Czechoslovakia)). 1992. [76p.] (In Czech). (CONF-9210351–: The mining town of Pribram in science and technology, Pribram (Czechoslovakia), 12-14 Oct 1992). In *The mining town of Pribram in science and technology. Abstracts of contributions.* Order Number DE93625342. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. RADIOACTIVE WASTES/radioactive waste processing; RADIOACTIVE WASTE DISPOSAL

22980 (INIS-mf–13518, pp. Z25) **Waste disposal activities at MAPE.** Urban, P. (DIAMO, o.z. Chemicka Upravna, Mydlovary (Czechoslovakia)). 1992. [76p.] (In Czech). (CONF-9210351–: The mining town of Pribram in science and technology, Pribram (Czechoslovakia), 12-14 Oct 1992). In *The mining town of Pribram in science and technology. Abstracts of contributions.* Order Number DE93625342. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. SEWAGE SLUDGE/radioactive waste processing; RADIOACTIVE WASTES; WASTE DISPOSAL

22981 (INIS-mf–13518, pp. LJ23) **National service of solid radioactive waste collection and disposal.** Janu, M. (Ustav pro Vyzkum, Vyrobu a Vyuziti Radioisotopu, Prague (Czechoslovakia)); Holub, J.; Marsal, J. 1992. [76p.] (In Czech). (CONF-9210351–: The mining town of Pribram in science and technology, Pribram (Czechoslovakia), 12-14 Oct 1992). In *The mining town of Pribram in science and technology. Abstracts of contributions.* Order Number DE93625342. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. RADIOACTIVE WASTES/radioactive waste processing; RADIOACTIVE WASTE DISPOSAL; RADIOACTIVE WASTE FACILITIES; SOLID WASTES

22982 (JAERI-M–93-077) **Adherent behavior of radioactive volatile substance on canister.** Togashi, Yoshihiro (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Tokai Research Establishment); Tashiro, Shingo. Japan Atomic Energy Research Inst., Tokyo (Japan). Mar 1993. 17p. (In Japanese). Order Number DE93797612. Source: OSTI; NTIS; INIS.

To clarify the adherent behavior of radioactive volatile substance to stainless steel which is used for the canister of glass solidification waste, contaminating and decontaminating tests were carried out on the basis of ^{137}Cs as a typical volatile substance. It was confirmed that the adhesion of the volatilized radioactive cesium on the stainless steel was almost loose contamination. The rate of the loose contamination increased with the contaminating time. The fixed contamination increased with the contaminating temperature. It was also found that the SUS309S stainless steel had a tendency to be contaminated as compared with SUS304L stainless steel and the contamination depended on the surface roughness of the stainless steel. (author).

22983 (K/CWM–18) **[Information exchange on current and planned low-level and transuranic waste management practices]: Foreign trip report, November 1–12, 1992.** Mezga, L.J. (Martin Marietta Energy Systems, Inc., Oak Ridge, TN (United States)); Radcliffe, L.L. Oak Ridge K-25 Site, TN (United States). 18 Jan 1993. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OT21400. Order Number DE93008859. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The traveler participated in discussions with British Nuclear Fuels Ltd. (BNFL) personnel regarding current low-level waste (LLW) and transuranic waste (TRU) management practices and procedures at the Sellafield Nuclear Facility. Specific discussion topics included LLW disposal practices at the Drigg Site, plutonium contaminated materials (PCM) management activities, waste characterization and certification programs and practices, and the status of repository development for low and intermediate level wastes (LLW and ILW) in the United Kingdom. Visits were made to the LLW disposal facility at Drigg, the high-level waste (HLW) vitrification facility, the waste treatment complex, the Waste Compaction and Monitoring Plant, an exploratory well site for the proposed LLW and ILW repository, and several plutonium - contaminated materials storage areas. This visit was conducted in conjunction with a subsequent visit to the SFR, the Swedish repository for LLW and ILW; the Studsvik Nuclear Research Facility; and the Forsmark Reactor.

22984 (K/ER–56) **Electromagnetic survey of the K1070A burial ground at the Oak Ridge K-25 Site, Oak Ridge, Tennessee: Environmental Restoration Program.** Nyquist, J.E.; Emery, M.S. Oak Ridge K-25 Site, TN (United States). Jan 1993. 28p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OT21400. Order Number DE93008690. Source: OSTI; NTIS; INIS; GPO Dep.

Environmental Sciences Division Publication 3988.

The K1070A burial ground, located at the K-25 Site on the Oak Ridge Reservation, received chemical and radioactive wastes from the late 1940s until 1975. Analysis of water samples collected from nearby monitoring wells indicates that contamination is migrating offsite. In November 1991, Oak Ridge National Laboratory (ORNL) personnel collected high-resolution electrical terrain conductivity data at the K1070A burial ground. A Model EM31 terrain conductivity meter manufactured by Geonics Limited was used in conjunction with the ORNL-developed Ultrasonic Ranging and Data System (USRADS) to perform the survey. The purposeof the survey was to provide Environmental Restoration (ER) staff with a detailed map of the spatial variation of the apparent electrical conductivity of the shallow subsurface (upper 3 m) to assist them in siting future monitoring wells closer to the waste area without drilling into the buried waste.

22985 (K/QT–389) **Effluent testing for the Oak Ridge mixed waste incinerator: Emissions test for August 27, 1990.** Bostick, W.D.; Bunch, D.H.; Gibson, L.V.; Hoffmann, D.P.; Shoemaker, J.L. Oak Ridge K-25 Site, TN (United States). Dec 1990. 48p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OT21400. Order Number DE93009333. Source: OSTI; NTIS; INIS; GPO Dep.

On August 27, 1990, a special emissions test was performed at the K-1435 Toxic Substance Control Act Mixed Waste Incinerator. A sampling and analysis plan was implemented to characterize the incinerator waste streams during a 6 hour burn of actual mixed waste. The results of this characterization are summarized in the present report. Significant among the findings is the observation that less than 3% of the uranium fed to the incinerator kiln was discharged as stack emission. This value is consistent with the estimate of 4% or less derived from long-term mass balance of previous operating experience and with the value assumed in the original Environmental Impact Statement. Approximately 1.4% of the total uranium fed to the incinerator kiln appeared in the aqueous scrubber blowdown; about 85% of the total uranium in the aqueous waste was insoluble (i.e., removable by filtration). The majority of the uranium fed to the incinerator kiln appeared in the ash material, apparently associated with phosphorous as a sparingly-soluble species. Many other metals of potential regulatory concern also appeared to concentrate in the ash as sparingly-soluble species, with minimal partition to the aqueous waste. The aqueous waste was discharged to the Central Neutralization Facility where it was effectively treated by coprecipitation with iron. The treated, filtered aqueous effluent met Environmental Protection Agency interim primary drinking water standards for regulated metals.

22986 (LA–12446-MS) **The nondestructive assay of 55-gallon drums containing uranium and transuranic waste using passive-active shufflers.** Rinard, P.M.; Adams, E.L.; Menlove, H.O.; Sprinkle, J.K. Jr. Los Alamos National Lab., NM (United States). Nov 1992. 100p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. Order Number DE93008854. Source: OSTI; NTIS; INIS; GPO Dep.

This study has been completed to characterize and improve the performance of passive-active neutron (PAN) shufflers in assaying 55gal. drums of nuclear facility waste for uranium and transuranic elements. Over 1700 active measurements and 800 passive measurements were made using 28 different matrices. Some of the matrices had homogeneous distributions of known amounts of moderating and absorbing materials, whereas others were less well characterized. Some of the well-characterized matrices simulate facility waste better than the others,especially matrices of paper, iron, polyethylene in nine different densities (with and without neutron poisons), alumina trap material, and concrete blocks.

22987 (LA–12528) **Partitioning high-level waste from alkaline solution: A literature survey.** Marsh, S.F. Los Alamos National Lab., NM (United States). May 1993. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. Order Number DE93013595. Source: OSTI; NTIS; INIS; GPO Dep.

Most chemical partitioning procedures are designed for acidic feed solutions. However, the high-level waste solutions in the underground storage tanks at US Department of Energy defense production sites are alkaline. Effective partitioning procedures for alkaline solutions could decrease the need to acidify these solutions and to dissolve the solids in acid, which would simplify subsequent processing and decrease the generation of secondary waste. The author compiles candidate technologies from his review of the chemical literature, experience, and personal contacts. Several of these are recommended for evaluation.

22988 (LA-SUB–92-12-Vol.1) **Impact of DOE Orders on Waste Management Operation: Volume 1: [Final report].** Klein, R.B. (Rogers and Associates Engineering Corp., Salt Lake City, UT (United States)); Jennrich, E.A.; Shuman, R.; Sandquist, G.M.; Rutz, A.C.; Littleton, M.W.; McCauce, C.H. Los Alamos National Lab., NM (United States); Rogers and Associates Engineering Corp., Salt Lake City, UT (United States); Wastren, Inc., Idaho Falls, ID (United States). Sep 1989. 77p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (RAE–8915/2-1). Order Number DE93008404. Source: OSTI; NTIS; INIS; GPO Dep.

Department of Energy Orders are the internal documents which govern the management of all Department of Energy facilities and operations. DOE Orders are the vehicles by which Federal and state laws and regulations are applied to Department of Energy activities. A selected set of 22 Department of Energy Orders was reviewed to identify the applicability and impact of each Order on waste management operations at Los Alamos National Laboratory. Of the 22 Orders reviewed, five set forth requirements which have a high degree of impact on waste management activities. Eight Orders have a moderate degree of impact on waste management activities, and the remaining nine Orders have a low degree of impact.

22989 (LA-SUB–92-12-Vol.2) **Engineering assessment of mixed waste management options: Volume 2: [Final report].** Davis, K.D. (Wastren, Inc., Idaho Falls, ID (United States)); Klein, R.B.; Jennrich, E.A. Los Alamos National Lab., NM (United States); Rogers and Associates Engineering Corp., Salt Lake City, UT (United States); Wastren, Inc., Idaho Falls, ID (United States). Dec 1989. 179p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (RAE–8915/3-2). Order Number DE93008405. Source: OSTI; NTIS; INIS; GPO Dep.

An engineering assessment of the low-level radioactive mixed waste (contains both radioactive and hazardous constituents) management program at Los Alamos National Laboratory was performed during the summer and fall of 1989. The assessment was aimed at developing recommendations for upgrading existing or developing new mixed waste treatment, storage, characterization, and disposal capabilities at the facility. The assessment was initiated with a comparison of actual waste containers in storage to (1) the records maintained on those wastes and to (2) planning estimates of the types and rates of mixed wastes produced. The various types of mixed waste, calculated in this study to be generated at an annual rate of 160 cubic meters (projected from 1989 data), were categorized into 30 groupings of similar characteristics. These groupings were further combined by the types of treatment required to allow the waste to be disposed in accordance with EPA requirements. Three broad categories of treatment needs were thus generated and potential treatment processes and methods to satisfy these needs were identified. On-site laboratory capabilities to perform analytical characterization of mixed waste were reviewed.

22990 (LA-SUB–93-51) **The Lathrop Wells volcanic center: Status of field and geochronology studies.** Crowe, B. (Los Alamos National Lab., Las Vegas, NV (United States)); Morley, R.; Wells, S.; Geissman, J.; McDonald, E.; McFadden, L.; Perry, F.; Murrell, M.; Poths, J.; Forman, S. Los Alamos National Lab., NM (United States). [1993]. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. Order Number DE93008917. Source: OSTI; NTIS; INIS; GPO Dep.

The Lathrop Wells volcanic center is located 20 km south of the potential Yucca Mountain site, at the south end of the Yucca Mountain range. It has long been recognized as the youngest basalt center in the region. However, determination of the age and eruptive history of the center has proven problematic. The purpose of this paper is to describe the status of field and geochronology studies of the Lathrop Wells center. Our perspective is that it is critical to assess all possible methods for obtaining cross-checking data to resolve chronology and field problems. It is equally important to consider application of the range of chronology methods available in Quaternary geologic research. Such an approach seeks to increase the confidence in data interpretations through obtaining convergence among separate isotopic, radiogenic, and age-correlated methods. Finally, the assumptions, strengths, and weaknesses of each dating method need to be carefully described to facilitate an impartial evaluation of results.

22991 (LA-SUB–93-92) **Recommendations for future low-level and mixed waste management practices at Los Alamos National Laboratory.** Jennrich, E.A. (Rogers and Associates Engineering Corp., Salt Lake City, UT (United States)); Klein, R.B.; Murphy, E.S.; Shuman, R.; Hickman, W.W.; Rutz, A.C.; Uhl, D.L. Los Alamos National Lab., NM (United States); Rogers and Associates Engineering Corp., Salt Lake City, UT (United States); Wastren, Inc., Idaho Falls, ID (United States). 27 Apr 1989. 164p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (RAE–8915-1). Order Number DE93008679. Source: OSTI; NTIS; INIS; GPO Dep.

This report describes recommendations concerning the management of low-level radioactive wastes and mixtures at Los Alamos National Laboratory. Performance assessments, characterization, site disposal design, shipment, and storage are discussed.

22992 (LA-UR–93-456) **Destruction of nitrates, organics, and ferrocyanides by hydrothermal processing.** Robinson, J.M.; Foy, B.R.; Dell'Orco, P.C.; Anderson, G.; Archuleta, F.; Atencio, J.; Breshears, D.; Brewer, R.; Eaton, H.; McFarland, R.; McInroy, R.; Reynolds, T.; Sedillo, M.; Wilmanns, E.; Buelow, S.J. Los Alamos National Lab., NM (United States). [1993]. 17p. Sponsored by USDOE, Washington, DC (United States); Associated Western Universities, Inc., Salt Lake City, UT (United States). DOE Contract W-7405-ENG-36. (CONF-930205–23: Waste management '93, Tucson, AZ (United States), 28 Feb - 4 mar 1993). Order Number DE93008714. Source: OSTI; NTIS; INIS; GPO Dep.

This work targets the remediation of the aqueous mixed wastes stored in the underground tanks at the Department of Energy site in Hanford, Washington via hydrothermal processing. The feasibility of destroying the nitrate, organic, and ferrocyanide components of the wastes under supercritical and near critical conditions (623 °K to 873°K, 22.1 MPa to 103.4 MPa) is addressed. A novel method was developed for determining the solubility of nitrate salts in supercritical water solutions at pressures ranging from 24.8 MPa to 30.3 MPa (3600 psi to 4400 psi) and temperatures from 723 °K to 798 °K. Sodium nitrate solubilities ranged from 293 mg/kg at 24.8 MPa and 798 °K to 1963 mg/kg at 30.3 MPa and 723°K. Solubility was found to vary directly with pressure, and inversely with temperature. An empirical relationship was developed for the estimation of sodium nitrate solubility at water densities between 0.08 and 0.16 kg/L and temperatures between 723°K and 798°K. A small volume batch reactor equipped with optical diagnostics was used to monitor the phase behavior of a diluted variant of a tank 101-SY simulant. Preliminary results suggest that a single phase is formed at 83 MPa at 773 °K.

22993 (LA-UR–93-656) **Migration barrier covers for radioactive and mixed waste landfills.** Hakonson, T.E. (Los Alamos National Lab., NM (United States)); Manies, K.L.; Warren, R.W.; Bostick, K.V.; Trujillo, G.; Kent, J.S.; Lane, L.J. Los Alamos National Lab., NM (United States). [1993]. 20p. Sponsored by USDOE, Washington, DC (United States); Department of Defense, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930188–1: Environmental restoration technology transfer symposium, Salt Lake City, UT (United States), 26-28 Jan 1993). Order Number DE93008728. Source: OSTI; NTIS; INIS; GPO Dep.

Migration barrier cover technology will likely serve as the remediation alternative of choice for most of DOE's radioactive and mixed waste landfills simply because human and ecological risks can be effectively managed without the use of more expensive alternatives. However, very little testing and evaluation has been done, either before or after installation, to monitor how effective they are in isolating waste or to develop data that can be used to evaluate model predictions of long term performance. Los Alamos National Laboratory has investigated the performance of a variety of landfill capping alternatives since 1981 using large field lysimeters to monitor the fate of precipitation falling on the cap surface. The objective of these studies is to provide the risk manager with a variety of field tested capping designs, of various complexities and costs, so that design alternatives can be matched to the need for hydrologic control at the site. Four different landfill cap designs, representing different complexities and costs, were constructed at Hill Air Force Base (AFB) in October and November, 1989. The designs were constructed in large lysimeters and instrumented to provide estimates of all components of water balance including precipitation, runoff (and soil erosion), infiltration, leachate production, evapotranspiration, and capillary/hydraulic barrier flow. The designs consisted of a typical soil cover to serve as a baseline, a modified EPA RCRA cover, and two versions of a Los Alamos design that contained erosion control measures, an improved vegetation cover to enhance evapotranspiration, and a capillary barrier to divert downward flow of soil water. A comprehensive summary

of the Hill AFB demonstration will be available in October 1993, when the project is scheduled to terminate.

22994 (LA-UR–93-697) **Oxygen sparging of residue salts.** Garcia, E.; Griego, W.J.; Owens, S.D.; Thorn, C.W.; Vigil, R.A. Los Alamos National Lab., NM (United States). [1993]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930571–7: 183. Electrochemical Society meeting, Honolulu, HI (United States), 16-21 May 1993). Order Number DE93008724. Source: OSTI; NTIS; GPO Dep.

Oxygen sparge is a process for treating salt residues at Los Alamos National Laboratory by sparging oxygen through molten salts. Oxygen reacts with the plutonium trichloride in these salts to form plutonium dioxide. There is further reaction of the plutonium dioxide with plutonium metal and the molten salt to form plutonium oxychloride. Both of the oxide plutonium species are insoluble in the salt and collect atthe bottom of the crucible. This results in a decrease of a factor of 2–3 in the amount of salt that must be treated, and the amount of waste generated by aqueous treatment methods.

22995 (LA-UR–93-998) **Application of geographic information systems to waste minimization efforts at Los Alamos National Laboratory.** Lyttle, T.W.; Smith, D.M.; Burns, M.; Weinrach, J.B. Los Alamos National Lab., NM (United States). [1993]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930523–1: 18. National Association of Environmental Professionals (NAEP) annual conference on current and future priorities for environmental management, Raleigh, NC (United States), 24-26 May 1993). Order Number DE93010726. Source: OSTI; NTIS; INIS; GPO Dep.

At Los Alamos National Laboratory (LANL), facility waste streams tend to be small but highly diverse. Initial characterization of such waste streams is often difficult in part due to a lack of tools to assist the generators themselves in completing such assessments. A methodology has been developed at LANL to allow process knowledgeable field personnel to develop baseline waste generation assessments and to evaluate potential waste minimization technology. This Process Waste Assessment (PWA) system is an application constructed within the Process Modeling System and currently being integrated with the InFoCAD Geographic Information System (GIS) . The Process Modeling System (PMS) is an object-oriented, mass balance-based, discrete-event simulation framework written using the Common Lisp Object System (CLOS) . Analytical capabilities supported within the PWA system include: complete mass balance specifications, historical characterization of selected waste streams and generation of facility profiles for materials consumption, resource utilization and worker exposure. Development activities include integration with the LANL facilities management Geographic Information System (GIS) and provisions for a Best Available Technologies (BAT) database. The environments used to develop these assessment tools will be discussed in addition to a review of initial implementation results.

22996 (LA-UR–93-1197) **Advanced oxidation and reduction processes: Closed-loop applications for mixed waste.** Coogan, J.J.; Tennant, R.A.; Rosocha, L.A.; Wantuck, P.J. Los Alamos National Lab., NM (United States). [1993]. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930873–8: 2. international mixed waste symposium, Baltimore, MD (United States), 17-20 Aug 1993). Order Number DE93012624. Source: OSTI; NTIS; INIS; GPO Dep.

At Los Alamos we are engaged in applying innovative oxidation and reduction technologies to the destruction of hazardous organics. Non thermal plasmas and relativistic electron-beams both involve the generation of free radicals and are applicable to a wide variety of mixed waste as closed-loop designs can be easily engineered. Silent discharge plasmas (SDP), long used for the generation of ozone, have been demonstrated in the laboratory to be effective in destroying hazardous organic compounds and offer an alternative to existing post-incineration and off-gas treatments. SDP generates very energetic electrons which efficiently create reactive free radicals, without adding the enthalpy associated with very high gas temperatures. A SDP cell has been used as a second stage to a LANL designed, packed-bed reactor (PBR) and has demonstrated DREs as high as 99.9999% for a variety of combustible liquid and gas-based waste streams containing scintillation fluids, nitrates, PCB surrogates, and both chlorinated and fluorinated solvents. Radiolytic treatment of waste using electron-beams and/or bremsstrahlung can be applied to a wide range of waste media (liquids, sludges, and solids). The efficacy and economy of these systems has been demonstrated for aqueous waste through both laboratory and pilot scale studies. We win present recent experimental and theoretical results for systems using stand alone SDP, combined PBR/SDP, and electron-beam treatment methods.

22997 (LA-UR–93-1204) **Treating water-reactive wastes.** Lussiez, G.W. Los Alamos National Lab., NM (United States). [1993]. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930873–9: 2. international mixed waste symposium, Baltimore, MD (United States), 17-20 Aug 1993). Order Number DE93012661. Source: OSTI; NTIS; INIS; GPO Dep.

Some compounds and elements, such as lithium hydride, magnesium, sodium, and calcium react violently with water to generate much heat and produce hydrogen. The hydrogen can ignite or even form an explosive mixture with air. Other metals may react rapidly only if they are finely divided. Some of the waste produced at Los Alamos National Laboratory includes these metals that are contaminated with radioactivity. By far the greatest volume of water-reactive waste is lithium hydride contaminated with depleted uranium. Reactivity of the water-reactive wastes is neutralized with an atmosphere of humid nitrogen, which prevents the formation of an explosive mixture of hydrogen and air. When we adjust the temperature of the nitrogen and the humidifier, the nitrogen can be more or less humid, and the rate of reaction can be adjusted and controlled. Los Alamos has investigated the rates of reaction of lithium hydride as a function of the temperature and humidity, and, as anticipated, they in with in temperature and humidity. Los Alamos will investigate other variables. For example, the nitrogen flow will be optimized to conserve nitrogen and yet keep the reaction rates high. Reaction rates will be determined for various forms of lithium waste, from small chips to powder. Bench work will lead to the design of a skid-mounted process for treating wastes. Other water-reactive wastes will also be investigated.

22998 (LBL–32874) **Radionuclide solubility and speciation studies for the Yucca Mountain site characterization project.** Nitsche, H.; Roberts, K.; Prussin, T.; Keeney, D.; Carpenter, S.A.; Becraft, K.; Gatti, R.C. Lawrence Berkeley Lab., CA (United States). Dec 1992. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. (CONF-930408–53: International high-level radioactive waste management conference, Las Vegas, NV (United States), 25-29 Apr 1993). Order Number DE93010444. Source: OSTI; NTIS; INIS; GPO Dep.

Yucca Mountain, Nevada, USA, is being investigated for its suitability as a potential site for a geologic nuclear waste repository. As part of the site characterization studies, actinide solubilities and speciations were studied at pH 6, 7, and 8.5 at 25°C in two different groundwaters from the vicinity of Yucca Mountain. The groundwaters differ substantially in total dissolved carbonate concentration, and to a lesser extent in ionic strength. In the waters with higher carbonate content, the solubilities of neptunium(V) decreased, whereas those americium(III) increased at 25°KC and decreased at 60°C. The solids formed were sodium neptunium carbonates and americium hydroxycarbonates. Plutonium solubilities did not significantly change with changing water composition because the solubility-controlling solids were mostly amorphous Pu(IV) polymers that contained only small amounts of carbonate.

22999 (LBL–33447) **Flow visualization and relative permeability measurements in rough-walled fractures.** Persoff, P.; Pruess, K. Lawrence Berkeley Lab., CA (United States). Jan 1993. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. (CONF-930408–72: International high-level radioactive waste management conference, Las Vegas, NV (United States), 25-29 Apr 1993). Order Number DE93013908. Source: OSTI; NTIS; INIS; GPO Dep.

Two-phase (gas-liquid) flow experiments were done in a natural rock fracture and transparent replicas of natural fractures. Liquid was injected at constant volume flow rate, and gas was injected at

either constant mass flow rate or constant pressure. When gas was injected at constant mass flow rate, the gas inlet pressure, and inlet and outlet capillary pressures, generally did not reach steady state but cycled irregularly. Flow visualization showed that this cycling was due to repeated blocking and unblocking of gas flow paths by liquid. Relative permeabilities calculated from flow rate and pressure data show that the sum of the relative permeabilities of the two phases is much less than 1, indicating that each phase interferes strongly with the flow of the other. Comparison of the relative permeability curves with typical curves for porous media (Corey curves) show that the phase interference is stronger in fractures than in typical porous media.

23000 (LBL–33464) **An inverse procedure for estimating the unsaturated hydraulic conductivities of volcanic tuffs.** Zimmerman, R.W. (Lawrence Berkeley Lab., CA (United States)); Bodvarsson, G.S.; Flint, A.L.; Flint, L.E. Lawrence Berkeley Lab., CA (United States). Jan 1993. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098 ;AI08-78ET44802. (CONF-930408–50: International high-level radioactive waste management conference, Las Vegas, NV (United States), 25-29 Apr 1993). Order Number DE93010421. Source: OSTI; NTIS; INIS; GPO Dep.

A procedure is developed for estimating the hydraulic conductivity function of unsaturated volcanic tuff, using measurements of the sorptivity and capillary pressure functions. The method assumes that the sorptivity is a linear function of the initial saturation, as is suggested by experimental data. The procedure is tested on a vitrified tuff from the Calico Hills unit at Yucca Mountain, and the predicted conductivities are in reasonable agreement with measured values. Further tests of this method are needed to establish whether or not it can be routinely used for conductivity predictions.

23001 (LBL–33614) **Geophysical methods for fracture characterization in and around potential sites for nuclear waste disposal.** Majer, E.L. (Lawrence Berkeley Lab., CA (United States)); Lee, K.H.; Morrison, H.F. Lawrence Berkeley Lab., CA (United States). Aug 1992. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. (CONF-920866–5: American Society of Civil Engineers (ASCE) symposium on dynamic analysis and design considerations, for high-level nuclear waste repositories, San Francisco, CA (United States), 19-20 Aug 1992). Order Number DE93010411. Source: OSTI; NTIS; INIS; GPO Dep.

Historically, geophysical methods have been used extensively to successfully explore the subsurface for petroleum, gas, mineral, and geothermal resources. Their application, however, for site characterization, and monitoring the performance of near surface waste sites or repositories has been somewhat limited. Presented here is an overview of the geophysical methods that could contribute to defining the subsurface heterogeneity and extrapolating point measurements at the surface and in boreholes to volumetric descriptions in a fractured rock. In addition to site characterization a significant application of geophysical methods may be in performance assessment and in monitoring the repository to determine if the performance is as expected.

23002 (LBL–33660) **Single fracture aperture patterns: Characterization by slit-island fractal analysis.** Cox, B.L.; Wang, J.S.Y. Lawrence Berkeley Lab., CA (United States). Jan 1993. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. (CONF-930408–49: International high-level radioactive waste management conference, Las Vegas, NV (United States), 25-29 Apr 1993). Order Number DE93010413. Source: OSTI; NTIS; INIS; GPO Dep.

Single fracture measurements are difficult to obtain, but they are the only means we have to observe and study natural fracture morphology. The character of the fracture openings (apertures) is often one of the primary factors controlling fluid flow in the fracture. In particular, the shape, distribution, and connectivity of contact areas and flow channels can affect the relative permeability of wetting and non-wetting fluid phases in unsaturated systems. In this paper we use three methods of fractal analysis (the slit-island, the divider, and the variogram) as well as statistical and geostatistical analysis to characterize the geometry of measured fracture apertures obtained from two different fractured rock specimens from the field. One of these is a granitic fracture (crack) of homogeneous lithology and no displacement, the other is a fracture (fault) obtained from a highly altered fault zone, containing striations and slickensides. We discuss the fractal and geostatistical analysis of these two fractures in the context of what information is most helpful for making predictions about fluid flow in single fractures.

23003 (LBL–33661) **The role of fault zones in affecting multiphase flow at Yucca Mountain.** Tsang, Y.W.; Pruess, K.; Wang, J.S.Y. Lawrence Berkeley Lab., CA (United States). Jan 1993. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. (CONF-930408–52: International high-level radioactive waste management conference, Las Vegas, NV (United States), 25-29 Apr 1993). Order Number DE93010431. Source: OSTI; NTIS; INIS; GPO Dep.

Within Yucca Mountain, the potential High Level Nuclear-Waste Repository site, there are large scale fault zones, most notably the Ghost Dance Fault. The effect of such high-permeability, large scale discontinuities on the flow and transport is a question of concern in assessing the ability of the site to isolate radio-nuclides from the biosphere. In this paper, we present a numerical study to investigate the role of the fault in affecting both the liquid and gas phase flows in the natural state at Yucca Mountain prior to waste emplacement, as well as after the waste emplacement when the fluid flow is strongly heat-driven. Our study shows that if the characteristic curves of the Ghost Dance Fault obey the same relationship between saturated permeability and capillary scaling parameter, as is observed from the measured data of Yucca Mountain welded and nonwelded tuffs. Apache Leap tuffs, and Las Cruces soil, then a large saturated permeability of the Ghost Dance Fault will play little role in channeling water into the fault, or inenhancing the flow of water down the fault. However, the Fault may greatly enhance the upward gas flow after emplacement of waste. This may have implications on the transport of gaseous radionuclides such as C^{14}. The results of this study also focus attention on the need for field measurements of fluid flow in the fault zones.

23004 (LBL–33663) **Flow and transport in hierarchically fractured systems.** Karasaki, K. Lawrence Berkeley Lab., CA (United States). Jan 1993. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. (CONF-930408–48: International high-level radioactive waste management conference, Las Vegas, NV (United States), 25-29 Apr 1993). Order Number DE93010414. Source: OSTI; NTIS; INIS; GPO Dep.

Preliminary results indicate that flow in the saturated zone at Yucca Mountain is controlled by fractures. A current conceptual model assumes that the flow in the fracture system can be approximately by a three-dimensionally interconnected network of linear conduits. The overall flow system of rocks at Yucca Mountain is considered to consist of hierarchically structured heterogeneous fracture systems of multiple scales. A case study suggests that it is more appropriate to use the flow parameters of the large fracture system for predicting the first arrival time, rather than using the bulk average parameters of the total system.

23005 (NEI-NO–332) **Storage for low-level and intermediate-level radioactive wastes: Consequence report in accordance with the Plan- and buildingregulation.** Statens Bygge- og Eiendomsdirekorat, Oslo (Norway). Nov 1992. [97p.] (In Norwegian). Order Number DE93626427. Source: OSTI; NTIS; INIS.

The objective of this report was to assess whether three nominated sites in Norway for underground storage of low-level and intermediate-level radioactive wastes would comply with safety standards and applicable laws and regulations. The site selection criteria are described and the report evaluates the technical, environmental and socio-economic suitability of the different sites. The site selection process eliminated two of the nominated sites, whereas one site was singled out. 28 refs., 14 figs., 10 tabs.

23006 (NUREG/CR–5917-Vol.1) **Sensitivity and uncertainty analyses applied to one-dimensional radionuclide transport in a layered fractured rock: MULTFRAC –Analytic solutions and local sensitivities: Phase 2, Iterative performance assessment: Volume 1.** Gureghian, A.B. (Southwest Research Inst., San Antonio, TX (United States). Center for Nuclear Waste Regulatory

Analyses); Wu, Y.T.; Sagar, B.; Codell, R.A. Nuclear Regulatory Commission, Washington, DC (United States). Div. of High-Level Waste Management; Southwest Research Inst., San Antonio, TX (United States). Center for Nuclear Waste Regulatory Analyses. Dec 1992. 131p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). (CNWRA–91-010-Vol.1). Source: OSTI; NTIS; INIS; GPO.

Includes 1 sheet of microfiche supplement.

Exact analytical solutions based on the Laplace transforms are derived for describing the one-dimensional space-time-dependent, advective transport of a decaying species in a layered, saturated rock system intersected by a planar fracture of varying aperture. These solutions, which account for advection in fracture, molecular diffusion into the rock matrix, adsorption in both fracture and matrix, and radioactive decay, predict the concentrations in both fracture and rock matrix and the cumulative mass in the fracture. The solute migration domain in both fracture and rock is assumed to be semi-infinite with non-zero initial conditions. The concentration of each nuclide at the source is allowed to decay either continuously or according to some periodical fluctuations where both are subjected to either a step or band release mode. Two numerical examples related to the transport of Np-237 and Cm-245 in a five-layered system of fractured rock were used to verify these solutions with several well established evaluation methods of Laplace inversion integrals in the real and complex domain. In addition, with respect to the model parameters, a comparison of the analytically derived local sensitivities for the concentration and cumulative mass of Np-237 in the fracture with the ones obtained through a finite-difference method of approximation is also reported.

23007 (NVO–325LRD-Rev.1) **Nevada Test Site defense waste acceptance criteria, certification, and transfer requirements laboratory reference document: Revision 1.** USDOE Nevada Field Office, Las Vegas, NV (United States); Reynolds Electrical and Engineering Co., Inc., Las Vegas, NV (United States). Waste Management Dept. Jun 1992. 143p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93008855. Source: OSTI; NTIS; INIS; GPO Dep.

Reference document NVO–325-Rev.1.

This document is a compilation of records forms used at the Nevada Test Site. These forms are identical in all respects to the forms found in the USEPA Contract Laboratory Program Statement of Work, excepting that all references and entries which are specific to the CLP have been deleted. The forms and all calculations required to produce them can be computer generated with instrument manufacturer's software.

23008 (NVO–325-Rev.1) **Nevada Test Site defense waste acceptance criteria, certification, and transfer requirements: Revision 1.** USDOE Nevada Field Office, Las Vegas, NV (United States); Reynolds Electrical and Engineering Co., Inc., Las Vegas, NV (United States). Waste Management Dept. Jun 1992. 126p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93008616. Source: OSTI; NTIS; INIS; GPO Dep.

Reference document NVO–325LRD-Rev.1.

The Nevada Test Site Defense Waste Acceptance Criteria, Certification, and Transfer Requirements establishes procedures, requirements, and criteria for safe transfer and disposal of low-level and mixed waste and storage of transuranic and transuranic mixed waste at the NTS. Included are the following: overview of the NTS Defense Waste Management Program, guidance for the application to dispose or store waste, the NTS waste acceptance criteria including the waste characterization certification requirements, and requirements for waste receipt.

23009 (NWPO-SE–045-92) **Social impacts of hazardous and nuclear facilities and events: Implications for Nevada and the Yucca Mountain high-level nuclear waste repository: [Final report].** Freudenburg, W.R. (Wisconsin Univ., Madison, WI (United States)); Carter, L.F.; Willard, W.; Lodwick, D.G.; Hardert, R.A.; Levine, A.G.; Kroll-Smith, S.; Couch, S.R. Nevada Nuclear Waste Project Office, Carson City, NV (United States). May 1992. 304p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG08-85NV10461. Order Number DE93013217. Source: OSTI; NTIS; INIS; GPO Dep.

Social impacts of a nuclear waste repository are described. Various case studies are cited such as Rocky Flats Plant, the Feed Materials Production Center, and Love Canal. The social impacts of toxic contamination, mitigating environmental stigma and loss of trust are also discussed.

23010 (NWPO-SE–054-92) **Expert judgment in assessing radwaste risks: What Nevadans should know about Yucca Mountain: [Final report].** Shrader-Frechette, K. (University of South Florida, Tampa, FL (United States)). Nevada Nuclear Waste Project Office, Carson City, NV (United States). Jun 1992. 225p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG08-85NV10461. Order Number DE93013216. Source: OSTI; NTIS; INIS; GPO Dep.

For phenomena characterized by accurate and largely complete data, quantitative risk assessment (QRA) provides extraordinarily valuable and objective information. However, with phenomena for which the data, models, or probabilities are incomplete or uncertain, QRA may be less useful and more questionable, because its conclusions are typically empirically and theoretically underdetermined. In the face of empirical or theoretical underdetermination, scientists often are forced to make a number of methodological value judgments and inferences about how to estimate and evaluate the associated risks. The purpose of this project is to evaluate instances of methodological value judgments and invalid or imprecise inferences that have occurred in the QRA done for the proposed Yucca Mountain high-level radioactive waste facility. We shall show (1) that questionable methodological value judgments and inferences have occurred in some Yucca Mountain QRA'S; (2) that questionable judgments and inferences, similar to those in the Yucca Mountain studies, have occurred in previous QRA's done for other radiation-related facilities and have likely caused earlier QRA's to err in specific ways; and (3) that, because the value judgments and problems associated with some Yucca Mountain QRA's include repetitions of similar difficulties in earlier studies, therefore the QRA conclusions of some Yucca Mountain analyses are, at best, uncertain.

23011 (NWPO-TR–017-91) **Quaternary tectonics and basin history of Pahrump and Stewart Valleys, Nevada and California.** Hoffard, J.L. (Nevada Univ., Reno, NV (United States)). Nevada Nuclear Waste Project Office, Carson City, NV (United States); Nevada Univ., Reno, NV (United States). May 1991. 212p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG08-85NV10461. Order Number DE93013214. Source: OSTI; NTIS; INIS; GPO Dep.

The Pahrump fault system is an active fault system located in Pahrump and Stewart Valleys, Nevada and California, in the southern part of the Basin and Range Province. This system is 50 km long by 30 km wide and is comprised of three fault zones: the right-lateral East Nopah fault zone, the right-oblique Pahrump Valley fault zone, and the normal West Spring Mountains fault zone. All three zones have geomorphic evidence for late Quaternary activity. Analysis of active fault patterns and seismic reflection lines suggests that the Pahrump basin has had a two-stage genesis, an early history associated with a period of low angle detachment faulting probably active 10-15 Ma, and a more recent history related to the present dextral shear system, probably active post-4 Ma.

23012 (NWPO-TR–018-91) **Mesozoic and Cenozoic structural geology of the CP Hills, Nevada Test Site, Nye County, Nevada; and regional implications.** Caskey, S.J. (Nevada Univ., Reno, NV (United States)). Nevada Nuclear Waste Project Office, Carson City, NV (United States); Nevada Univ., Reno, NV (United States). Aug 1991. 203p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG08-85NV10461. Order Number DE93013215. Source: OSTI; NTIS; INIS; GPO Dep.

Detailed mapping and structural analysis of upper Proterozoic and Paleozoic rocks in the CP Hills of the Nevada Test Site, together with analysis of published maps and cross sections and a reconnaissance of regional structural relations indicate that the CP thrust of Barnes and Poole (1968) actually comprises two separate, oppositely verging Mesozoic thrust systems: (1) the west-vergent CP thrust which is well exposed in the CP Hills and at Mine Mountain, and (2) the east-vergent Belted Range thrust located

northwest of Yucca Flat. West-vergence of the CP thrust is indicated by large scale west-vergent recumbent folds in both its hangingwall and footwall and by the fact that the CP thrust ramps up section through hangingwall strata toward the northwest. Regional structural relations indicate that the CP thrust forms part of a narrow sigmoidal belt of west-vergent folding and thrusting traceable for over 180 km along strike. The Belted Range thrust represents earlier Mesozoic deformation that was probably related to the Last Chance thrust system in southeastern California, as suggested by earlier workers. A pre-Tertiary reconstruction of the Cordilleran fold and thrust belt in the region between the NTS and the Las Vegas Range bears a close resemblance to other regions of the Cordillera and has important implications for the development of hinterland-vergent deformation as well as for the probable magnitude of Tertiary extension north of Las Vegas Valley. Subsequent to Mesozoic deformation, the CP Hills were disrupted by at least two episodes of Tertiary extensional deformation: (1) an earlier episode represented by pre-middle Miocene low-angle normal faults, and (2) a later, post-11 Ma episode of high-angle normal faulting. Both episodes of extension were related to regional deformation, the latter of which has resulted in the present basin and range topography of the NTS region.

23013 (ORNL/FTR–4473) **[Principles and criteria for radioactive waste disposal]: Foreign trip report, October 24–30, 1992.** Kocher, D.C. Oak Ridge National Lab., TN (United States). 13 Nov 1992. 21p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93009778. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The traveler attended, as a representative of the U. S. Department of Energy, the second meeting of the International Radioactive Waste Management Advisory Committee Subgroup on Principles and Criteria for Radioactive Waste Disposal. The primary purpose of the subgroup is to discuss and develop consensus recommendations on fundamental and largely philosophical issues related to long-term safety principles and criteria for radioactive waste disposal.

23014 (ORNL/TM–12297) **Liquid and Gaseous Waste Operations Department annual operating report, CY 1992.** Gillespie, M.A.; Maddox, J.J.; Scott, C.B. Oak Ridge National Lab., TN (United States). Mar 1993. 105p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93013459. Source: OSTI; NTIS; INIS; GPO Dep.

A total of 6.05 x 10^7 gal of liquid waste was decontaminated by the Process Waste Treatment Plant (PWTP) ion exchange system during CY 1992. This averaged to 115 gpm throughout the year. When necessary, a wastewater sidestream of 50–80 gpm was treated through the use of a natural zeolite treatment system. An additional 8.00 x 10^6 gal (average of 15 gpm throughout the year) were treated by the zeolite system. Therefore, the average total flow treated at the PWTP for CY 1992 was 130 gpm. In mid-June, the zeolite system was repiped to allow it the capability to treat the ion exchange system's discharge due to rising Cs problems in the wastewater. While being used to treat the ion exchange system's discharge, it cannot treat a sidestream of wastewater. During the year, the regeneration of the cation exchange resins resulted in the generation of 7.83 x 10^3 gal of liquid low-level waste (LLLW) concentrate and 1.15 x 10^4 gal of LLLW evaporator feed. The head-end softening process (precipitation/clarification) generated 604 drums (4.40 x 10^3 ft^3) of solid low-level waste sludge. The zeolite treatment system generated approximately 8.40 x 10^2 ft^3 of spent zeolite resin, which was turned over to the Solid Waste Operations Department for disposal. See Table 1 for a monthly summary of activities at the PWTP. Figures 1, 2, 3, and 4 show a comparison of operations at the PWTP in 1992 with previous years. Figure 5 shows a comparison of annual rainfall at Oak Ridge National Laboratory (ORNL) since 1987. A total of 1.55 x 10^8 gal of liquid waste (average of 294 gpm throughout the year) was treated at the Nonradiological Wastewater Treatment Plant (NRWTP). Of this amount, 1.40 x 10^7 gal were treated by the precipitation/clarification process for removal of heavy metals. Twenty-five boxes (1.60 x 10^3 ft^3) of solid sludge generated by the precipitation/clarification process were removed from the filter press room.

23015 (PNL–8492) **Leach testing of in situ stabilization grouts containing additives to sequester contaminants.** Serne, R.J. (Pacific Northwest Lab., Richland, WA (United States)); Ames, L.L.; Martin, P.F.C.; LeGore, V.L.; Lindenmeier, C.W.; Phillips, S.J. Pacific Northwest Lab., Richland, WA (United States). Apr 1993. 48p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93012861. Source: OSTI; NTIS; INIS; GPO Dep.

This document discusses laboratory testing performed by Pacific Northwest Laboratory (PNL) for Westinghouse Hanford Company (WHC) of special grout formulations that incorporate specific sequestering agents to help improve the ability of the cement to resist contaminant leaching. To enhance the sequestering of contaminants we chose five additives to introduce (singly) to the control cement. The additives were Florida pebble phosphate, clinoptilolite (a natural zeolite), ferrous sulfide (a reductant), a mixed bed organic ion exchange resin and a proprietary anion-adsorbing mixed metal oxide. These additives were added one per test to the standard formulation and used to encapsulate a diluted high-salt alkaline liquid waste that is produced after various processes to remove uranium and plutonium from spent nuclear fuel. This report documents the testing of these additives.

23016 (PNL–8502) **First-order study of property/composition relationships for Hanford Waste Vitrification Plant glasses.** Piepel, G.F.; Hrma, P.R.; Bates, S.O.; Schweiger, M.J.; Smith, D.E. Pacific Northwest Lab., Richland, WA (United States). Jan 1993. 146p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93007931. Source: OSTI; NTIS; INIS; GPO Dep.

A first-order composition variability study (CVS-I) was conducted for the Hanford Waste Vitrification Plant (HWVP) program to preliminarily characterize the effects on key glass properties of variations i selected glass (waste and frit) components. The components selected were SiO_2,B_2O_3,Al_2O_3, Fe_2O_3, ZrO_2, Na_2O,Li_2O,CaO,MgO, and Others (all remaining waste components). A glass composition region was selected for study based on the expected range of glass compositions and the results of a previous series of scoping and solubility studies. Then, a 23-glass statistically-designed mixture experiment was conducted and data obtained for viscosity, electrical conductivity, glass transition temperature, thermal expansion, crystallinity, and durability [Materials Characterization Center (MCC-1) 28-day leach test and the 7-day Product Consistency Test (PCT)]. These data were modeled using first-order functions of composition, and the models were used to investigate the effects of the components on glass and melt properties. The CVS-I data and models will also be used to support the second-order composition variability study (CVS-II).

23017 (PNL–8618) **106-AN grout pilot-scale test HGTP-93-0501-02.** Bagaasen, L.M. Pacific Northwest Lab., Richland, WA (United States). May 1993. 123p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93013110. Source: OSTI; NTIS; INIS; GPO Dep.

The Grout Treatment Facility (GTF) at Hanford, Washington will process the low-level fraction of selected double-shell tank (DST) wastes into a cementitious waste form. This facility, which is operated by Westinghouse Hanford Company (WHC), mixes liquid waste with cementitious materials to produce a waste form that immobilizes hazardous constituents through chemical reactions and/or microencapsulation. Over 1,000,000 gal of Phosphate/Sulfate Waste were solidified in the first production campaign with this facility. The next tank scheduled for treatment is 106-AN. After conducting laboratory studies to select the grout formulation, part of the normal formulation verification process is to conduct tests using the 1/4-scale pilot facilities at the Pacific Northwest Laboratory (PNL). The major objectives of these pilot-scale tests were to determine if the proposed grout formulation could be processed in the pilot-scale equipment and to collect thermal information to help determine the best way to manage the grout hydration heat.

23018 (PNL-SA–20281) **A methodology to predict the uniformity of double-shell waste slurries based on mixer pump operation.** Liljegren, L.M.; Bamberger, J.A. Pacific Northwest Lab., Richland, WA (United States). Aug 1992. 17p. Sponsored by

USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-920808–15: American Institute of Chemical Engineers (AIChE) summer national meeting, Minneapolis, MN (United States), 9-12 Aug 1992). Order Number DE93007866. Source: OSTI; NTIS; INIS; GPO Dep.

Dimensional analysis is used to determine the similarity parameters that describe the uniformity of radioactive slurry wastes to be suspended by mixer pumps. The results of this analysis are applied to the design of scaled experiments that will determine the operating parameters that will ensure an adequately uniform feed stream during waste retrieval from Hanford double-shell tanks. Ten dimensionless parameters describing the slurry mixing process were identified. Of these, three describe purely geometric features, three describe slurry properties only, one is a dimensionless time scale, and three describe important dynamic factors. The three parameters describing the dynamic features are the Reynolds number, which describes the degree of turbulence in the tank; the Froude number, which describes the effects of stratification on the circulation patterns; and the gravitational settling number, which describes the balance between the work done by gravity to cause settling and the work done by the pump to resuspend particles.

23019 (PNL-SA–20592) **Performance assessment for low-level radioactive waste management and disposal at DOE facilities: Requirements, review process, and lessons learned.** Neuder, S.M. (Pacific Northwest Lab., Washington, DC (United States)); Wilhite, E.L. Pacific Northwest Lab., Richland, WA (United States). Apr 1992. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-920466–17: Engineering and technology conference on waste management and environmental restoration, San Juan (Puerto Rico), 9-11 Apr 1992). Order Number DE93008258. Source: OSTI; NTIS; INIS; GPO Dep.

Department of Energy (DOE) facilities, located at sites across the nation, generate large quantities and a wide variety of low-level radioactive waste (LLRW) from nuclear defense production and research and development activities. All DOE-generated LLRW is disposed of at DOE disposal sites. Most DOE waste generating sites do not have disposal facilities on site and so must ship their LLRW to one of six currently active DOE disposal locations. Four disposal sites are located in generally arid regions: the Hanford Reservation (HANF) in the state of Washington, the Nevada Test Site (NTS), the Idaho National Engineering Laboratory (INEL), and the Los Alamos National Laboratory (LANL) in New Mexico. The other two disposal sites are located in the humid southeast: The Savannah River Plant (SRP) in South Carolina and the Oak Ridge National Laboratory (ORNL) in Tennessee.

23020 (PNL-SA–20802) **DOE mixed wastes: What are they and where can thermal technologies be applied?.** Ross, W.A. (Pacific Northwest Lab., Richland, WA (United States)); Borduin, L.C.; Musgrave, B.C. Pacific Northwest Lab., Richland, WA (United States). May 1992. 19p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-920527–11: 1992 incineration conference, Albuquerque, NM (United States), 11-14 May 1992). Order Number DE93008259. Source: OSTI; NTIS; INIS; GPO Dep.

The Mixed Waste Treatment Project (MWTP) has collected and analyzed mixed low-level waste data to assist in developing treatment capability for the US Department of Energy is (DOE) wastes. Initial data on the characteristics of mixed waste was obtained from the Waste Management Information System (WMIS) data base, and has been updated based on visits to DOE sites where most of the wastes are generated and stored. The streams of interest to the MWTP have a current inventory of about 70,000 m^3 and a generation rate of about 7,700 m^3/yr. The 12 sites with the most significant processing needs are Fernald, Hanford, K-25 (Oak Ridge), Idaho National Engineering Laboratory (INEL), Lawrence Livermore National Laboratory (LLNL), Los Alamos National Laboratory (LANL), Oak Ridge National Laboratory (ORNL), Paducah Gaseous Diffusion Plant, Portsmouth Gaseous Diffusion Plant, Rocky Flats Plant (RFP), Savannah River Site (SRS), and Y-12 (Oak Ridge). These 12 sites account for about 98% of the mixed waste volumes. The wastes have been assigned to specific waste characterization categories and a flowsheet that identifies applicable technologies has been developed. The largest waste stream category, when considering the current inventory in storage, is inorganic solids, with sludges, filter cakes, and residues the largest specific subcategories. Aqueous liquids are the largest currently generated stream. The other large categories are solid organics, metals wastes, and heterogenous wastes. Organic liquids, which have been a major focus, are the smallest of the categories. The major thermal treatment units include evaporators, incinerators, vitrifiers, metal melters, and off-gas treatment systems.

23021 (PNL-SA–21258) **Non-fuel bearing hardware melting technology.** Newman, D.F. Pacific Northwest Lab., Richland, WA (United States). Apr 1993. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-930408–68: International high-level radioactive waste management conference, Las Vegas, NV (United States), 25-29 Apr 1993). Order Number DE93013162. Source: OSTI; NTIS; INIS; GPO Dep.

Several utilities have decided to consolidate spent fuel rods in order to increase the storage capacity of their reactor pools cost-effectively. Fuel rod compaction of 2:1 has been achieved through disassembly of spent fuel and placing all the rods from two assemblies into a canister that will fit in a single assembly's rack space. The non-fuel bearing hardware (NFBH) left over from the disassembly still occupies about 1/3 of the volume of the consolidated fuel after compaction. This report discusses melting of NFBH which, in conjunction with rod consolidation of spent fuel assemblies can increase spent fuel.storage capacity more than 30% beyond that possible with underwater low-pressure compaction of this hardware.

23022 (PNL-SA–21393) **High-level waste management and treatment program for The Analytical Laboratory.** King, A.G.; Baldwin, D.L.; Steele, R.T.; Poston, K.A. Pacific Northwest Lab., Richland, WA (United States). Feb 1993. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-930205–37: Waste management '93, Tucson, AZ (United States), 28 Feb - 4 mar 1993). Order Number DE93009340. Source: OSTI; NTIS; INIS; GPO Dep.

A new program has been successfully implemented for the treatment, storage, and disposal of high-level radioactive mixed wastes generated during chemical and radiological analysis at the Pacific Northwest Laboratory in Richland, Washington. This shielded laboratory facility has effectively treated RCRA waste generated predominantly from analyses of radioactive samples obtained during the Tank Waste Characterization Program on the Hanford Site. Several batches of the radioactive mixed waste, generated during the full analytical characterization of four Hanford Single Shell Tank cores and the partial characterization of three other cores, were combined and successfully treated during January through August of 1992. The waste treatment process was specifically designed to treat a low-pH, high-chloride, high-gamma activity waste stream. The creation of the treatment, storage and disposal facility required an extensive six-month permit modification process resulting in state and federal regulatory approval.

23023 (PNL-SA–21394) **Low-level radioactive waste from nuclear power generating stations: Characterization, classification and assessment of activated metals and waste streams.** Thomas, V.W.; Robertson, D.E.; Thomas, C.W. Pacific Northwest Lab., Richland, WA (United States). Feb 1993. 9p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-930205–38: Waste management '93, Tucson, AZ (United States), 28 Feb - 4 mar 1993). Order Number DE93009339. Source: OSTI; NTIS; INIS; GPO Dep.

Since the enactment of 10 CFR Part 61, additional difficult-to-measure long-lived radionuclides, not specified in Tables 1 2 of Part 61, have been identified (e.g., ^{108m}Ag, ^{93}Mo, ^{36}Cl, ^{10}Be, ^{113m}Cd, ^{121m}Sn, ^{126}Sn, ^{93m}Nb) that may be of concern in certain types of waste. These nuclides are primarily associated with activated metal and perhaps other nuclear power low-level waste (LLW) being sent to disposal facilities. The concentration of a radionuclide in waste materials is normally determined by direct measurement or by indirect calculational methods, such as using a

scaling factor to relate inferred concentration of a difficult-to-measure radionuclide to another that is easily measured. The total disposal site inventory of certain difficult-to-measure radionuclides (e.g., ^{14}C, ^{129}I, and ^{99}Tc) often control the total quantities of radioactive waste permitted in LLW burial facilities. Overly conservative scaling factors based on lower limits of detection (LLD), often used in the nuclear power industry to estimate these controlling nuclides, could lead to premature closure of a disposal facility. Samples of LLW (Class B and C activated metals [AM] and other waste streams) are being collected from operating nuclear power stations and analyzed for radionuclides covered in 10 CFR Part 61 and the additional difficult-to-measure radionuclides. This analysis will enhance the NRC's understanding of the distribution and projected quantities of radionuclides within AM and LLW streams from commercial nuclear power stations. This research will also provide radiological characterization of AM specimens for others to use in leach-rate and lysimeter experiments to determine nuclide releases and subsequent movement in natural soil environments.

23024 (PNL-SA–21453) **Quantitative measurement of cyanide species in simulated ferrocyanide Hanford waste.** Bryan, S.A.; Pool, K.H.; Matheson, J.D. Pacific Northwest Lab., Richland, WA (United States). Feb 1993. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-930205–33: Waste management '93, Tucson, AZ (United States), 28 Feb - 4 mar 1993). Order Number DE93009479. Source: OSTI; NTIS; INIS; GPO Dep.

Analytical methods for the quantification of cyanide species in Hanford simulated high-level radioactive waste were pursued in this work. Methods studied include infrared spectroscopy (solid state and solution), Raman spectroscopy, Moessbauer spectroscopy, X-ray diffraction, scanning electron microscopy-electron dispersive spectroscopy (SEM-EDS), and ion chromatography. Of these, infrared, Raman, X-ray diffraction, and ion chromatography techniques show promise in the concentration range of interest. Quantitation limits for these latter four techniques were demonstrated to be approximately 0.1 wt% (as cyanide) using simulated Hanford wastes.

23025 (PNL-SA–21459) **Best Available Technology (BAT) guidance for radiological liquid effluents at US Department of Energy Facilities.** Wallo, A. III (USDOE Assistant Secretary for Environment, Safety, and Health, Washington, DC (United States)); Peterson, H.T. Jr.; Ikenberry, T.A.; Baker, R.E. Pacific Northwest Lab., Richland, WA (United States). Jan 1993. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-930130–12: 26. Health Physics Society midyear topical meeting on environmental health physics, Coeur d'Alene, ID (United States), 24-28 Jan 1993). Order Number DE93007886. Source: OSTI; NTIS; INIS; GPO Dep.

The US Department of Energy (DOE), in DOE Order 5400.5 (1990), directs operators of DOE facilities to apply the Best Available Technology (BAT) to control radiological liquid effluents from these facilities when specific conditions are present. DOE has published interim guidance to assist facility operators in knowing when a BAT analysis is needed and how such an analysis should be performed and documented. The purpose of the guidance is to provide a uniform basis in determining BAT throughout DOE and to assist in evaluating BAT determinations during programmatic audits. The BAT analysis process involves characterizing the effluent source; identifying and selecting candidate control technologies; evaluating the potential environmental, operational, resource, and economic impacts of the control technologies; developing an evaluation matrix for comparing the technologies; selecting the BAT; and documenting the evaluation process. The BAT analysis process provides a basis for consistent evaluation of liquid effluent releases, yet allows an individual site or facility the flexibility to address site-specific issues or concerns in the most appropriate manner.

23026 (PNL-SA–21463) **Tank waste chemistry: A new understanding of waste aging.** Babad, H. (Westinghouse Hanford Co., Richland, WA (United States)); Camaioni, D.M.; Lilga, M.A.; Samuels, W.D.; Strachan, D.M. Pacific Northwest Lab., Richland, WA (United States). Feb 1993. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-930205–31: Waste management '93, Tucson, AZ (United States), 28 Feb - 4 mar 1993). Order Number DE93009475. Source: OSTI; NTIS; INIS; GPO Dep.

There is concern about the risk of uncontrolled exothermic reactions(s) in Hanford Site waste tanks containing NO_{3minus}/NO_{2minus} based salts and/or metal hydroxide sludges in combination with organics or ferrocyanides. However, gradual oxidation of the waste in the tanks to less reactive species appears to have reduced the risk. In addition, wastes sampled to date contain sufficiently large quantities of water so that propagation reactions are highly unlikely. This report details an investigation into the risk of an uncontrolled exothermic reaction in Hanford Site high-activity water tanks.

23027 (PNL-SA–21559) **Waste glass melting stages.** Anderson, L.D.; Dennis, T.; Elliott, M.L.; Hrma, P. Pacific Northwest Lab., Richland, WA (United States). Apr 1993. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-930438–15: 95. annual meeting of the American Ceramic Society, Cincinnati, OH (United States), 18-22 Apr 1993). Order Number DE93013166. Source: OSTI; NTIS; INIS; GPO Dep.

Three different simulated nuclear waste glass feeds, consisting of dried waste and glass frit, were heat treated for 1 hour in a gradient furnace at temperatures ranging from approximately 600°C–1000°C. Simulated melter feeds from the Hanford Waste Vitrification Plant (HWVP), the Defense Waste Processing Facility (DWPF), and Kernforschungszentrum Karlsruhe (KfK) in Germany were used. The samples were thin-sectioned and examined by optical microscopy to investigate the stages of the conversion from feed to glass. Various phenomena were seen, such as frit softening, bubble formation, foaming, bubble motion and removal, convective mixing, and homogenization. Behavior of different feeds was similar, although the degree of gas generation and melt homogenization varied.

23028 (PNL-SA–21856) **Results of vitrifying Fernald OU-4 wastes.** Merrill, R.A. (Pacific Northwest Lab., Richland, WA (United States)); Janke, D.S. Pacific Northwest Lab., Richland, WA (United States). Feb 1993. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-930205–50: Waste management '93, Tucson, AZ (United States), 28 Feb - 4 mar 1993). Order Number DE93010167. Source: OSTI; NTIS; INIS; GPO Dep.

Three silos in Operable Unit 4 (OU-4) at the Feed Materials Production Center in Fernald, Ohio, contain residues from the processing of pitchblende ores. Silos 1 and 2, designated as K-65, contain the depleted ore with a BentoGrout cap over the material to reduce radon emanation, while Silo 3 contains calcined residue from processing solutions. The residues in the three silos contain radium, uranium, uranium daughters, and heavy metals (primarily lead). Vitrification tests were carried out on various mixtures of the above materials and the resulting glasses were analyzed. The vitrified residues all tested "non-hazardous" by the Toxicity Characteristic Leachate Procedure (TCLP) and demonstrated a high degree of durability by the Product Consistency Test (PCT). The specific gravity and radon emanation of both the vitrified and non-vitrified residue were measured. Volume reductions ranging from 50 to 68 percent were obtained while the radon emanation rate was reduced by a factor of about 500,000. Radon emanation from the vitrified residue is of the same order of magnitude as emanation from natural building materials such as brick or concrete.

23029 (PNL-SA–21893) **Low temperature hydrothermal processing of organic contaminants in Hanford tank waste.** Jones, E.O. (Pacific Northwest Lab., Richland, WA (United States)); Pederson, L.R.; Freeman, H.D.; Schmidt, A.J.; Babad, H. Pacific Northwest Lab., Richland, WA (United States). Feb 1993. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-930205–46: Waste management '93, Tucson, AZ (United States), 28 Feb - 4 mar 1993). Order Number DE93009815. Source: OSTI; NTIS; INIS; GPO Dep.

Batch and continuous flow reactor tests at Pacific Northwest Laboratory (PNL) have shown that organics similar to those present in the single-shell and double-shell underground storage tanks at Hanford can be decomposed in the liquid phase at relatively mild temperatures of 150°C to 350°C in an aqueous process known as hydrothermal processing (HTP). The organics will react with the abundant oxidants such s nitrite already present in the

Hanford tank waste to form hydrogen, carbon dioxide, methane, and ammonia. No air or oxygen needs to be added to the system. Ferrocyanides and free cyanide will hydrolyze at similar temperatures to produce formate and ammonia and may also react with nitrates or other oxides. During testing, the organic carbon was transformed first to oxalate at~310°C and completely oxidized to carbonate at ~350°C accompanied by hydroxide consumption. Solids were formed at higher temperatures, causing a small-diameter outlet tube to plug. The propensity for plugging was reduced by diluting the feed with concentrated hydroxide.

23030 (PNL-SA–22047) **Risk management in facility transition and management decision making: Needs and opportunities.** Stillwell, W. (Pacific Northwest Lab., Richland, WA (United States)); Seaver, D.; Keller, J.; Smith, D.; Weaver, D.; Sanders, T.; Thullen, P. Pacific Northwest Lab., Richland, WA (United States). Feb 1993. 19p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-930205–42: Waste management '93, Tucson, AZ (United States), 28 Feb - 4 mar 1993). Order Number DE93009813. Source: OSTI; NTIS; INIS; GPO Dep.

An overall approach to risk management is described in this paper. Many of these concepts have been developed and applied as part of Hanford Mission Planning (HMP) (Hanford Mission Plan, 1992). At Hanford, HMP provides a mechanism for integrating planning across all the missions and programs of the site. This paper discusses the decision context within which EM must make and defend decisions, the types of decisions that are being and will need to be made in order to progress with the cleanup of the DOE complex, and the resulting need for risk management. Risk management, in turn, requires quality health and ecological risk information to make these decisions. Other types of information are also needed, but the risk information is typically the most important and the most difficult to obtain. The paper then describes a general technical approach to risk management, including particular methods for developing the high quality of human health and ecological risk information that will be needed to support risk management. We next turn to several special issues that make risk management more complex than many other decisions. We discuss these issues and offer some practical suggestions with respect to addressing them in the risk management framework. Finally, we conclude with some discussion of other opportunities for applying risk management.

23031 (PNL-SA–22264) **AREST: The next generation.** Engel, D.W. (Pacific Northwest Lab., Richland, WA (United States)); McGrail, B.P.; Eslinger, P.W.; Altenhofen, M.K. Pacific Northwest Lab., Richland, WA (United States). Apr 1993. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-930408–70: International high-level radioactive waste management conference, Las Vegas, NV (United States), 25-29 Apr 1993). Order Number DE93013165. Source: OSTI; NTIS; INIS; GPO Dep.

Simple mass transport models using constant boundary conditions at the waste form surface and at the host rock boundary do not always result in realistic predictions of the performance of an underground repository for the disposal of high-level radioactive waste. What is needed is a model that couples the important processes that can not be modeled independently, including (1) thermal modeling, (2) geochemical modeling, (3) containment degradation, (4) waste form dissolution, and (5) radionuclide transport. Such a model is being developed by modifying the AREST code.

23032 (POEF/ER/Sub–88/4551/D1-Vol.1) **Quadrant III RFI draft report: Volume 1.** Portsmouth Gaseous Diffusion Plant, OH (United States); Geraghty and Miller, Inc., Dublin, OH (United States). Environmental Services. Dec 1992. 531p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-76OR00001. Order Number DE93007778. Source: OSTI; NTIS; INIS; GPO Dep.

The purpose of the RCRA Facility Investigation (RFI) at The Portsmouth Gaseous Diffusion Plant (PORTS) is to acquire, analyze and interpret data that will: characterize the environmental setting, including ground water, surface water and sediment, soil and air; define and characterize sources of contamination; characterize the vertical and horizontal extent and degree of contamination of the environment; assess the risk to human health and the environment resulting from possible exposure to contaminants; and support the Corrective Measures Study (CMS), which will follow the RFI, if required. A total of 18 Solid Waste Management Units (SWMU's) were investigated. All surficial soil samples (0–2 ft), sediment samples and surface-water samples proposed in the approved Quadrant III RFI Work Plan were collected as specified in the approved work plan and RFI Sampling Plan. All soil, sediment and surface-water samples were analyzed for parameters specified from the Target Compound List and Target Analyte List (TCL/TAL) as listed in the US EPA Statement of Work for Inorganic (7/88a) and Organic (2/88b) analyses for Soil and Sediment, and analyses for fluoride, Freon-113 and radiological parameters (total uranium, gross alpha, gross beta and technetium).

23033 (PTE–1) **Research and development work on radioactive waste management and underground burial of chemical-toxic wastes - first half of 1991.** Kernforschungszentrum Karlsruhe GmbH (Germany). Projekttraegerschaft Entsorgung. Dec 1991. 112p. (In German). Order Number DE93792711. Source: OSTI; NTIS (US Sales Only); INIS.

The progress report documents the intermediate and final results of the work on decommissioning of nuclear installations and ultimate disposal of hazardous wastes. The subjects dealt with are, in particular, concept, planning, assurance of due concentration, normal operational and post-operational phases, and accident control and limitation of consequences during operational and post-operational phases. A list of the research institutions involved is attached. (orig.).

23034 (RFP–4611) **Low-level waste sorting of small packages.** Wishard, B.E. (EG and G Rocky Flats, Inc., Golden, CO (United States). Rocky Flats Plant); Harlan, R.A.; Anderson, B.P.; Peterson, K.; Caldwell, J.T. EG and G Rocky Flats, Inc., Golden, CO (United States). Rocky Flats Plant. [1993]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC34-90DP62349. (CONF-9305180–1: FG&G cadet conference, Idaho Falls, ID (United States), 13-14 May 1993). Order Number DE93012702. Source: OSTI; NTIS; INIS; GPO Dep.

An active neutron interrogation system utilizing the differential die-away technique (DDT), was built to assay fissile material in small waste packages for a variety of matrices. Within minutes the system can make a "go/no-go" decision for sorting low-level waste (LLW) from transuranic waste (TRUW). It can also provide gram-level accountability of weapons-grade (WG) Pu in TRUW providing lumps of self-shielding fissile material are absent.

23035 (SAND–91-2733) **Investigations of deteriorated concrete from the liner of the Waste Isolation Pilot Plant Waste Shaft.** Nowak, E.J. (Sandia National Labs., Albuquerque, NM (United States)); Wakeley, L.D.; Poole, T.S.; Burkes, J.P. Sandia National Labs., Albuquerque, NM (United States). Jun 1992. 102p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. Order Number DE93011475. Source: OSTI; NTIS; INIS; GPO Dep.

During inspections of the Waste Isolation Pilot Plant Waste Shaft in May 1990, patchy areas of apparently degraded concrete were observed on the inner surface of the shaft liner between approximately 810 feet and 900 feet below the surface. The apparent cause of this degradation is chemical reaction of the concrete with magnesium-bearing brine in the annulus between the concrete liner and the host rock. The greater thickness of the degraded layer below the joint may be related to the different chemical compositions that were determined by analyses of the paste portions of concrete samples from above and below the joint. The analytical results support a complex mechanistic explanation of concrete degradation observed behind the liner and in the joint: chemical weakening of the concrete paste; cracking by precipitation of solids in pores; and increased permeability due to calcium chloroaluminate formation. Additional sampling, analyses, and regular monitoring are worth considering to bound the vertical extent of Waste Shaft liner degradation, detect concrete liner degradation in other shafts, and measure any ongoing degradation that may be occurring.

23036 (SAND–92-1148) **The use of formal and informal expert judgments when interpreting data for performance assessments.** Rechard, R.P. (Sandia National Labs., Albuquerque, NM (United States)); Trauth, K.M.; Tierney, M.S.; Rath, J.S.; Guzowski, R.V.; Hora, S.C. Sandia National Labs., Albuquerque, NM (United States). Feb 1993. 24p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. Order Number DE93012394. Source: OSTI; NTIS; INIS; GPO Dep.

This paper discusses the general process by which data and information are compiled and used for defining modeling parameters. These modeling parameters are input for the mathematical models that are used in performance assessments of the Waste Isolation Pilot Plant (WIPP), near Carlsbad, NM, which is designed to safely manage, store, and dispose of transuranic radioactive wastes. The physical and temporal scales, and the difficulty of obtaining measurements in geologic media make interpretation of measured data, including the difference between laboratory experiment scale and repository scale, important tasks. In most instances, standard scientific practices can ensure consistency of data use. To illustrate this point, an example is provided of the interpretation of field measurements of intrinsic permeability for use in computational models using the bootstrap technique. In some cases, sufficient information can never be collected, interpretation of the information is controversial, or information from diverse disciplines must be used. A procedure that formalizes the standard scientific practices under these conditions has been developed. An example is provided of how this procedure has been applied in eliciting expert judgments on markers to deter inadvertant human intrusion into the WIPP.

23037 (SAND–92-1537C) **Three-dimensional finite element simulation of creep deformation in rock salt.** Weatherby, J.R.; Munson, D.E.; Argueello, J.G. Sandia National Labs., Albuquerque, NM (United States). [1992]. 37p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-930889–1: 2. U.S. National Congress on Computational Mechanics meeting, Washington, DC (United States), 16-18 Aug 1993). Order Number DE93011595. Source: OSTI; NTIS; INIS; GPO Dep.

A multi-mechanism deformation (M-D) constitutive model for rock salt has been implemented in a finite element code for use in three-dimensional, finite strain simulations of creep closure in deeply-buried salt excavations. Essential details of the numerical implementation are presented. The constitutive model is exercised in a three-dimensional closure simulation of a large underground field experiment. Finally, results from the simulation are compared against actual closure measurements taken from the experiment.

23038 (SAND–92-1934C) **Updated recommendations for low-level waste performance assessment.** Kozak, M.W.; Olague, N.E. Sandia National Labs., Albuquerque, NM (United States). [1993]. 9p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-930396–11: Waste management '93, Tucson, AZ (United States), 1-5 Mar 1993). Order Number DE93011599. Source: OSTI; NTIS; INIS; GPO Dep.

A low-level radioactive waste performance assessment methodology was developed by Sandia National Laboratories for use by the US Nuclear Regulatory Commission in evaluating license applications under 10 CFR Part 61. The purpose of the methodology is to allow confirmation of a licensee's evaluation of postclosure impacts, to provide reasonable assurance that the performance objectives in 10 CFR Part 61.41 are met. Subsequent work has been undertaken to update and improve the methodology where necessary, and to build confidence in the models in the methodology. Since developing the methodology, it has been applied several times to test cases. This additional experience allows an improved assessment of the modeling needs. This paper assesses the adequacy of the current models, and identifies additional models that may be useful to include in the methodology. Models that have become available since the preparation of the original methodology are discussed. In addition, a formal process for low-level waste performance assessment and treatment of uncertainty is recommended, and model validation is examined.

23039 (SAND–92-2285) **Conceptual structure of performance assessments conducted for the Waste Isolation Pilot Plant.** Helton, J.C. (Arizona State Univ., Tempe, AZ (United States)); Marietta, M.G.; Rechard, R.P. Sandia National Labs., Albuquerque, NM (United States). Apr 1993. 31p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. Order Number DE93013948. Source: OSTI; NTIS; INIS; GPO Dep.

The Waste Isolation Pilot Plant (WIPP) in southeastern New Mexico is being developed by the US Department of Energy as a disposal facility for transuranic waste. In support of this project, Sandia National Laboratories is conducting an ongoing performance assessment (PA) for the WIPP. The ordered triple representation for risk proposed by Kaplan and Garrick is used to provide a clear conceptual structure for this PA. This presentation describes how the preceding representation provides a basis in the WIPP PA for (1) the definition of scenarios and the calculation of scenario probabilities and consequences, (2) the separation of subjective and stochastic uncertainties, (3) the construction of the complementary cumulative distribution functions required in comparisons with the US Environmental Protection Agency's standard for the geologic disposal of radioactive waste (i.e., 40 CFR Part 191, Subpart B), and (4) the performance of uncertainty and sensitivity studies. Results obtained in a preliminary PA for the WIPP completed in December of 1991 are used for illustration.

23040 (SAND–92-2660C) **Details of in situ sample retrievals and test completion for the Materials Interface Interactions Test (MIIT).** Molecke, M.A. (Sandia National Labs., Albuquerque, NM (United States)); Wicks, G.G. Sandia National Labs., Albuquerque, NM (United States); Westinghouse Savannah River Co., Aiken, SC (United States). [1992]. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789 ;AC09-76SR00001. (CONF-930438–11: 95. annual meeting of the American Ceramic Society, Cincinnati, OH (United States), 18-22 Apr 1993). Order Number DE93012350. Source: OSTI; NTIS; INIS; GPO Dep.

The Materials Interface Interaction Tests (MIIT) program involves the comparative, performance-evaluation testing of multiple US and foreign nuclear waste glasses (nonradioactive), potential canister and overpack metals, brine, and geologic materials in the rock salt repository environment at the Waste Isolation Pilot Plant (WIPP) facility. We emplaced about 2000 materials specimens onto 50 test assemblies and exposed them to a 90 $\pm$ 10°C salt-brine environment. We successfully concluded the in situ conduct of the MIIT after five years and retrieved all samples for posttest laboratory analyses. These 5-year glass and metal samples, along with samples previously retrieved after 0.5, 1, and 2 years, are being analyzed in multiple international laboratories, in a cooperative testing effort. Our focus in this paper is to summarize technical details and repository-relevant observations on the in situ conduct, sampling, and termination operations of the MIIT. Such information should be useful for the interpretation of the laboratory-based analyses and also relevant for other organizations planning or conducting similar materials-related, in situ tests.

23041 (SAND–92-2670C) **Investigation of fracture-matrix interaction: Preliminary experiments in a simple system.** Foltz, S.D. (New Mexico Univ., Albuquerque, NM (United States). Dept. of Physics and Astronomy); Tidwell, V.C.; Glass, R.J.; Sobolik, S.R. Sandia National Labs., Albuquerque, NM (United States). [1992]. 30p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-930408–65: International high-level radioactive waste management conference, Las Vegas, NV (United States), 25-29 Apr 1993). Order Number DE93011580. Source: OSTI; NTIS; INIS; GPO Dep.

Paramount to the modeling of unsaturated flow and transport through fractured porous media is a clear understanding of the processes controlling fracture-matrix interaction. As a first step toward such an understanding, two preliminary experiments have been performed to investigate the influence of matrix imbibition on water percolation through unsaturated fractures in the plane normal to the fracture. Test systems consisted of thin slabs of either tuff or an analog material cut by a single vertical fracture into which a constant fluid flux was introduced. Transient moisture content and solute concentration fields were imaged by means of x-ray absorption. Flow fields associated with the two different media were

significantly different owing to differences in material properties relative to the imposed flux. Richards' equation was found to be a valid means of modeling the imbibition of water into the tuff matrix from a saturated fracture for the current experiment.

23042 (SAND–92-2679C) **A concept to combine DOE waste minimization goals with commercial utility needs for a universal container system for spent nuclear fuel storage, transportation, and disposal.** Falci, F.P. (USDOE, Washington, DC (United States)); Sorenson, K.B.; Smith, M.L. Sandia National Labs., Albuquerque, NM (United States). [1992]. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-930408–60: International high-level radioactive waste management conference, Las Vegas, NV (United States), 25-29 Apr 1993). Order Number DE93009855. Source: OSTI; NTIS; INIS; GPO Dep.

Two major initiatives are underway in the US that are creating a significant financial impact on both the US taxpayer and on users of electric power. First, the US Department of Energy (DOE) has been tasked with cleaning-up the defense complex. This task is managed under the direction of the Office of Environmental Restoration and Waste Management (EM) of the DOE. The waste that EM must address includes radioactive, hazardous, and mixed that consists of both radioactive and hazardous constituents. Second, the DOE is required by the Nuclear Waste Policy Act (NWPA) to take title to commercial nuclear spent fuel assemblies starting in 1998. The DOE Office of Civilian Radioactive Waste Management (OCRWM) was established to carry out this charter. Since a final repository is not scheduled for opening until 2010 at the earliest, the DOE is planning on providing a Monitored Retrievable Storage (MRS) facility for centralized storage to bridge the time gap between 1998 and 2010. The NWPA requires that nuclear utilities pay a fee into a specific fund that Congress uses to pay the DOE for the development of the MRS, the transportation system, and the repository. This fund, along with the EM budget, constitutes a multi-billion dollar effort to manage DOE nuclear waste and to store and dispose of commercial spent nuclear fuel. These two seemingly unrelated problems have aspects of commonality that can be considered for the benefit of both programs, the US taxpayer, and the utility rate payer. Both programs are the responsibility of the DOE, and both will require engineered packages for storage, transportation, and disposal of the EM waste and commercial spent fuel. Rather than using specialized systems for each step (storage, transport, and disposal), a concept for a Universal Container System has been developed that could potentially simplify the overall waste management system, reduce expensive handling operations, and reduce total system cost.

23043 (SAND–92-7072) **Waste Isolation Pilot Plant Salado hydrology program data report No. 2.** Stensrud, W.A. (INTERA, Inc., Austin, TX (United States)); Dale, T.F.; Domski, P.S.; Palmer, J.B.; Roberts, R.M.; Fort, M.D.; Saulnier, G.J. Jr.; Jensen, A.L. Sandia National Labs., Albuquerque, NM (United States). Dec 1992. 477p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. Order Number DE93012398. Source: OSTI; NTIS; INIS; GPO Dep.

WIPP Salado Hydrology Program Data Report #2 presents hydrologic data collected during permeability testing of the Salado Formation performed from August 1989 through July 1992. The report presents the results of the drilling and testing of six boreholes drilled from the WIPP underground facility 655 m below ground surface in the Salado Formation. Permeability tests were conducted using multipacker test tools with inflatable packers to isolate borehole intervals to allow formation pore-pressure buildup and subsequent pressure-pulse and constant-pressure-withdrawal tests. The tests performed in boreholes L4P51, L4P52, SCP01, S1P71, S1P72, an S1P73 involved Marker Beds 138 and 139, anhydrites "a," "b," and "c," clays B, D, E, G, H, J, and K, and several halitic strata. Test data include pressure and temperature from the brine-filled, packer- isolated test intervals, fluid and gas production during constant- pressure-withdrawal tests, and borehole-closure and axial test tool- movement measurements. The boreholes were drilled and/or cored to nominal 10.2-cm diameters using compressed air to remove drill cuttings. Compliance tests were conducted in lengths of steel and stainless-steel casing to evaluate the mechanical performance of the multipacker test tools. Compliance tests included leak tests and pulse-injection and pulse-withdrawal sequences. Following permeability testing, fluid pressures were monitored in packer- isolated sections of test boreholes C2H01, C2H02, SCP01, SIP71, SIP72, DPD01, DPD02, and DPD03.

23044 (SAND–92-7306) **A modeling approach to address spatial variability within the Culebra Dolomite transmissivity field.** LaVenue, A.M. (INTERA, Inc., Albuquerque, NM (United States)); RamaRao, B.S. Sandia National Labs., Albuquerque, NM (United States); INTERA, Inc., Albuquerque, NM (United States); INTERA, Inc., Austin, TX (United States). Dec 1992. 130p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. Order Number DE93012395. Source: OSTI; NTIS; INIS; GPO Dep.

Spatial estimates of transmissivity, which are essential input to a groundwater flow model, are usually developed from a limited number of transmissivity measurements and therefore associated with an uncertainty. In an attempt to assess the spatial variability of the unmeasured transmissivities within the Culebra Dolomite near the Waste Isolation Pilot Plant (WIPP), a multiple realization approach is employed. An innovative aspect of the methodology is the generation of an ensemble of conditional simulations of the transmissivity field, which preserves the statistical moments and spatial correlation structure of the measured transmissivity field and horrors the measured values at their locations. Each simulation is then calibrated, using an iterative procedure, to match an exhaustive set of steady-state and transient pressure data. A completely automated inverse algorithm using pilot points as parameters of calibration was employed. The methodology was applied to the transmissivity fields for the Culebra Dolomite aquifer, and 70 conditional simulations were produced and calibrated. Based on an analysis of the calibrated transmissivity fields, additional data in a region east and north of the H-3 borehole would help to more accurately characterize the transmissivity of the region and reduce the uncertainty in calculating groundwater travel times. Progress in these areas would, in, turn, reduce the uncertainty in the prediction of concentrations at the accessible environment boundary.

23045 (UCRL-CR–109772) **Chemical health risk assessment for hazardous and mixed waste management units at Lawrence Livermore National Laboratory: Volume 1.** Lawrence Livermore National Lab., CA (United States); Radian Corp., Sacramento, CA (United States). Sep 1992. 204p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE93009574. Source: OSTI; NTIS; INIS; GPO Dep.

The Lawrence Livermore National Laboratory (LLNL) operates three Hazardous Waste Management Facilities with 24 associated waste management units for the treatment and storage of hazardous and mixed wastes. These wastes are generated by research programs and support operations. The storage and treatment units are presently operated under interim status in accordance with the requirements of the US Envirorunental Protection Agency (US EPA) and the Department of Toxic Substances Control (DTSC), a division of the California Envirorunental Protection Agency (Cal/EPA). As required by the California Hazardous Waste Control Act and the Resource Conservation and Recovery Act (RCRA), LLNL ha s applied for a Part B permit to continue operating the storage and waste treatment facilities. As part of this permitting process, LLNL is required to conduct a health risk assessment (HRA) to examine the potential health impacts to the surrounding community from continued storage and treatment of hazardous and mixed wastes. analysis document presents the results of this risk assessment. An analysis of maximum credible chemical accidents is also included in Section 7.0. This HRA was prepared in accordance with procedures set forth by the California Air Pollution Control Officers Association (CAPCOA) "Air Toxics Assessment Manual," CAPCOA guidelines for preparing risk assessments under the Air Toxic "Hot Spots" Act (AB 2588) and requirements of the US EPA. By following these procedures, this risk assessment presents a conservative analysis of a hypothetical Maximally Exposed Individual (MEI) using many worst-case assumptions that will not apply to an actual individual. As such, the

risk estimates presented should be regarded as a worst-case estimate of any actual risk that may be present.

23046 (UCRL-CR–112802-Vol.1) **Construction quality assurance closure report, Lawrence Livermore National Laboratory Site 300, Pits 1 and 7: Volume 1, Text, tables, figures, and appendices A–D.** Lawrence Livermore National Lab., CA (United States); Golder Associates, Inc., Alameda, CA (United States). Feb 1993. 555p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE93009575. Source: OSTI; NTIS; INIS; GPO Dep.

This document presents the Final Construction Quality Assurance (CQA) report for the closure cover system of two mixed, low-level radioactive and hazardous waste landfills (pits) at Site 300. Site 300, operated by the Lawrence Livermore National Laboratory (LLNL), is located in the Altamont Hills, approximately 15 miles southeast of Livermore, California. The purpose of this report is to document the CQA program established to assure that construction is completed in accordance with the design intent and the approved Closure and Post Closure Plans dated May 1989 and revised January 1990 (EPA ID Number: CA 2890090002). Inclusive within the Closure and Post Closure Plan were the CQA Plan and the Technical Specifications for the final cover system. This report contains a complete narrative with photographic documentation of the construction activities and progress, problems encountered and solutions utilized, and third party testing and monitoring results, thus establishing the verification of compliance with the Quality Assurance Plan for the project.

23047 (UCRL-CR–112802-Vol.2) **Construction quality assurance closure report, Lawrence Livermore National Laboratory Site 300, Pits 1 and 7: Volume 2, Appendices E–P.** Lawrence Livermore National Lab., CA (United States); Golder Associates, Inc., Alameda, CA (United States). Feb 1993. 606p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE93009576. Source: OSTI; NTIS; GPO Dep.

This document presents the Final Construction Quality Assurance (CQA) report for the closure cover system of two mixed, low-level radioactive and hazardous waste landfills (pits) at Site 300. Site 300, operated by the Lawrence Livermore National Laboratory (LLNL), is located in the Altamont Hills, approximately 15 miles southeast of Livermore, California. The purpose of this report is to document the CQA program established to assure that construction is completed in accordance with the design intent and the approved Closure and Post Closure Plans dated May 1989 and revised January 1990 (EPA ID Number: CA 2890090002). Inclusive within the Closure and Post Closure Plan were the CQA Plan and the Technical Specifications for the final cover system. This document consists of Appendices E through P and contains information and drawings related to the cover system.

23048 (UCRL-ID–108067) **Closure report for Building 875 sump encased in concrete.** Montemayor, W. Lawrence Livermore National Lab., CA (United States). Aug 1991. 29p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE93009446. Source: OSTI; NTIS; INIS; GPO Dep.

This report will document the post-closure activities for the 875-R1U1 Waste-Solvent Underground Storage Tank located at Lawrence Livermore National Laboratory (LLNL), Site 300. The aforementioned tank waspreviously identified and registered with the California Water Resources Control Board as 875-31R. The underground tank system consists of a 55-gallon steel drum encased in concrete. The underground tank was used to collect dripping and spillage from the above-concrete drum rack storage area. The closure of this underground tank was permitted as Tank Identification No. 39-1945-21 by W.R. Snavely of SJCPHS-EHS. The last tank test, performed on February 1988, showed that the underground tank was leak tight. On May 1988, the sludge at the bottom of the tank was removed and disposed of as hazardous waste. The residual 1.5 inches of oily water in the tank was removed and the tank was washed with soap and water on December 11, 1989. The rinsate and residual sludge was disposed of as hazardous waste. The empty tank and the encasing concrete were extracted from the ground on November 5, 1990. No underground piping was associated with the removal of this underground tank since the tank was used to collect the dripping and spillage from the above-concrete drum rack. Three soil samples were collected in split tubes from approximately 1 foot below the bottom of the tank. The soil samples were collected and analyzed for Total Petroleum Hydrocarbon (TPH)-Gasoline, TPH-Diesel, Total Extractable Petroleum, Benzene, Toluene, Xylene, Ethyl Benzene, Tetraethyl Lead, Metals, Polychlorinated Biphenyls (PCB), and Ethylene Dibromide. Results indicated that the underground tank was leak tight. The concrete encasing was removed from the 55-gallon tank and disposed of as a municipal waste. The 55-gallon tank is currently stored at the Hazardous Waste Storage Area located in Lawrence Livermore National Laboratory, Livermore, California and is waiting as a hazardous waste.

23049 (UCRL-ID–113718) **Study of plutonium volatility under microwave melting conditions used for glass encapsulation of plutonium sludge wastes: Final report.** Krikorian, O.H.; Condit, R.H.; Fontes, A.S. Jr.; Morris, W.F.; Magana, J.W.; Lougheed, R.W. Lawrence Livermore National Lab., CA (United States). 20 Apr 1993. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE93014367. Source: OSTI; NTIS; GPO Dep.

Transpiration measurements have been made to evaluate the extent of Pu volatilities expected during microwave melting of Pu sludge/glass mixtures. Measurements have been made at 2% PuO_2 and 0.03% PuO_2 in Pu sludge/glass mixtures, where Pu is found to volatilize as $PuO_2(OH)_2(g)$ at pressures of the order of 10^{-10} to 10^{-11} atm at melt temperatures of ~1400 K. The data are extrapolated to the actual expected conditions of Pu contents of 0.0003% in the Pu sludge/glass mix, at a melt temperature of 1500 K, O_2 pressure of 0.2 atm, and H_2O pressure 0.1 atm. The pressure of $PuO_2(OH)_2(g)$ is estimated to be 8×10^{-14} atm under these conditions. An estimate is also given of $AmO_2(OH)_2(g)$ volatility of 4×10^{-17} atm when ^{241}Am is present at a level of 500 ppM in the Pu.

23050 (UCRL-JC–108815) **The dissolution rate of UO_2 in the alkaline regime under oxidizing conditions using a simplified ground water analog.** Leider, H.R.; Nguyen, S.N.; Weed, H.C.; Steward, S.A. Lawrence Livermore National Lab., CA (United States). Jan 1992. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-920430–104: 3. international high level radioactive waste management (IHLRWM) conference, Las Vegas, NV (United States), 12-16 Apr 1992). Order Number DE93009314. Source: OSTI; NTIS; INIS; GPO Dep.

The major factor controlling the long term release of radionuclides from spent fuel in a geologic repository is the leaching/dissolution by groundwater of the UO_2 matrix, since more than 90% of the radionuclide waste is contained in the fuel matrix. The objective of this investigation is to provide experimental dissolution rates for UO_2 samples which can be used to develop a mechanistic release model (or models) for UO_{2+x} ($x \geq 0$) under repository conditions. Several types of data will be obtained from this study: (1) the dissolution rates of UO_2 as a function of pI-L temperature, carbonate and oxygen fugacity; (2) the comparison of the steady state dissolution rates of "not-reduced" versus "reduced" UO_2 samples and of single crystal versus polycrystalline UO_2 under identical experimental conditions; (3) the pre- and post-test surface analyses of the samples to provide information on the surface phases that may be formed under experimental conditions.

23051 (UCRL-JC–109901) **Mixed Waste Treatment Project – Scope and status.** Coleman, J. (USDOE Environmental Restoration and Waste Management, Washington, DC (United States). Office of Waste Operations); Cowan, S.; Harmon, L.H.; Rhoderick, J.; Borduin, L.C.; Musgrave, B.C.; Ross, W.A. Lawrence Livermore National Lab., CA (United States). Mar 1992. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-920307–93: Waste management '92, Tucson, AZ (United States), 1-5 Mar 1992). Order Number DE93012492. Source: OSTI; NTIS; INIS; GPO Dep.

Department of Energy (DOE) facilities currently store and generate significant quantities of mixed wastes - mixtures of materials containing both radioactive and hazardous chemical contamination.

These wastes must be managed in compliance with DOE requirements and EPA Land Disposal Restrictions. To help meet these requirements for low-level mixed wastes, the DOE Office of Waste Operations has established The Mixed Waste Treatment Project (MWTP). The overall goal of the MWTP is demonstration of effective treatment of low-level mixed wastes in a full-scale prototype plant. The MWTP staff, supported by a technical committee comprised of waste operations representatives from Hanford, Idaho, Los Alamos, Oak Ridge, Rocky Flats and Savannah River have reviewed the three major DOE data bases, the Integrated Data Base, the National Report on Prohibited Wastes and the Waste Management Information System data base managed by HAZWRAP. Database upgrades to meet MWTP needs are being pursued by field visits to the major mixed waste generators. A reference flowsheet was developed for treatment of low level contact handled mixed wastes. Technology gaps identified by these analyses are being used by DOE Waste Operations, and the Office of Technology Development to define technology development needs. A brief analysis of options for deployment of capabilities to treat mixed wastes at DOE facilities nationwide has been conducted.

23052 (UCRL-JC–110079) **Closure of Building 624 incinerator.** Ridley, M.N.; Hallisey, M.L.; Terusaki, S.; Steverson, M. Lawrence Livermore National Lab., CA (United States). Jun 1992. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-920527–15: 1992 incineration conference, Albuquerque, NM (United States), 11-14 May 1992). Order Number DE93013199. Source: OSTI; NTIS; GPO Dep.

The Building 624 incinerator was a Resource Conservation Recovery Act (RCRA) mixed waste incinerator at Lawrence Livermore National Laboratory (LLNL). This incinerator was in operation from 1978 to 1989. The incinerator was to be closed as a mixed waste incinerator, but was to continue burning classified nonhazardous solid waste. The decision was later made to discontinue all use of the incinerator. Closure activities were performed from June 15 to December 15, 1991, when a clean closure was completed. The main part of the closure was the characterization, which included 393 samples and 30 blanks. From these 393 samples, approximately 13 samples indicated the need for further investigation, such as an isotopic scan; however, none of the samples was concluded to be hazardous or radioactive.

23053 (UCRL-JC–110826) **Experimental A&PCT research and development efforts to characterize mixed-waste forms.** Martz, H.E.; Roberson, G.P.; Robert-Coutant, C.; Camp, D.C. Lawrence Livermore National Lab., CA (United States). 15 Dec 1992. 20p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-920882–3: Transuranic waste characterization conference, Pocatello, ID (United States), 10-12 Aug 1992). Order Number DE93007510. Source: OSTI; NTIS; INIS; GPO Dep.

Characterization of mixed wastes requires that the identity and strengths of intrinsic radioactive sources be determined accurately and that all hazardous materials be identified. We have a three-phased R&D effort to address the nondestructive assay (NDA) of 208-L canisters. These phases are (1) experimental active (A) and passive (P) computed tomography (CT) R&D, (2) simulated A&PCT R&D, and (3) determination of minimum-detectable limits vs waste-matrix attenuation. We report here on the experimental effort; reports on the other two efforts are also published in these proceedings. Experimental data were acquired on a small-scale canister containing mock wastes and two passive sources (95-μCi ^{133}Ba and 74-μCi ^{228}Th) using a CT scanner built in-house. These data are used to investigate the use of (1) ACT to obtain images that represent cross-sectional attenuation maps of a wastecanister's contents; (2) PCT to locate and determine the identity of any radioisotopic sources present; and (3) ACT data to correct the PCT data so that accurate source strengths can be determined. Multiple, monoenergetic ACT images, which yield effective atomic number data, were used to investigate whether hazardous materials could be identified by means of their effective atomic numbers.

23054 (UCRL-JC–110827) **Simulated A&PCT data to study the mixed waste forms characterization problem.** Robert-Coutant, C.; Martz, H.E.; Azevedo, S.G. Lawrence Livermore National Lab., CA (United States). 30 Nov 1992. 18p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-920882–4: Transuranic waste characterization conference, Pocatello, ID (United States), 10-12 Aug 1992). Order Number DE93009282. Source: OSTI; NTIS; INIS; GPO Dep.

Characterization of mixed wastes requires that the identity and strengths of all intrinsic radioactive sources be determined accurately and all hazardous materials identified. We have investigated the nondestructive evaluation/assay (NDE/NDA) of 208-L drums with active (A) and passive (P) computed tomography (CI) in three phases: (1) computer simulation, (2) experimental measurements, and (3) determination of minimum-detectable limits for various x-ray and gamma-ray attenuation properties typical of waste containers. We report here on the simulation effort; the other two are also presented elsewhere in these proceedings.1 The A&PCT process consists of mapping the activity of intrinsic sources using PCT data and correcting the data for attenuation by A matrix obtained from an ACT scan. Simulated data are necessary to better understand A&PCT reconstruction algorithms, measure their performance, and better interpret experimental data. The simulation program is based on a forward-projection algorithm to discretely compute the projections (i.e., integrated counts per unit time per unit area) of an emitting object attenuated by a user-specified matrix. We use two algebraic, iterative, A&PCT reconstruction codes: a weighted-least-squares, steepest-descent (WLS-SD) algorithm and a maximum-likelihood expectation-maximization (MLEM) algorithm. We present three simulated phantom studies: (1) a large homogeneous source included in a large homogeneous attenuator, (2) a mock-waste drum involving small sources, and (3) a spatial-resolution phantom. All examples involve attenuation but are not strong enough to cause missing data, and the last example includes noise. Simulated results are reported and analyzed in the context of mixed-waste characterization.

23055 (UCRL-JC–112397) **Waste salt recovery, recycle, and destruction.** Hickman, R.G. Lawrence Livermore National Lab., CA (United States). Dec 1992. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-930160–13: 2. semi-annual Office of Technology Development (OTD) information meeting, Houston, TX (United States), 26-28 Jan 1993). Order Number DE93009289. Source: OSTI; NTIS; INIS; GPO Dep.

Starting in 1943 and continuing into the 1970s, radioactive wastes resulting from plutonium processing at Hanford were stored underground in 149 single shell tanks. Of these tanks, 66 are known or believedto be leaking, and over a period are believed to have leaked about 750,000 gal into the surrounding soil. The bulk of the aqueous solution has been removed and transferred to double shell tanks, none of which are leaking. The waste consists of 37 million gallons of salt cake and sludge. Most of the salt cake is sodium nitrate and other sodium salts. A substantial fraction of the sludge is sodium nitrate. Small amounts of the radionuclides are present in the sludge as oxides or hydroxides. In addition, some of the tanks contain organic compounds and ferrocyanide complexes, many of which have undergone radiolytic induced chemical changes during the years of storage. As part of the Hanford site remediation effort, the tank wastes must be removed, treated, and the residuals must be immobilized and disposed of in an environmentally acceptable manner. Removal methods of the waste from the tanks fall generally into three approaches: dry removal, slurry removal, and solution removed. The latter two methods are likely to result in some additional leakage to the surrounding soil, but that may be acceptable if the tank can be emptied and remediated before the leaked material permeates deeply into the soil. This effort includes three parts: salt splitting, acid separation, and destruction, with initial emphasis on salt splitting.

23056 (UCRL-LR–107476-Vol.2) **Preliminary near-field environment report: Volume 2, Scientific overview of near-field environment and phenomena.** Wilder, D.G. Lawrence Livermore National Lab., CA (United States). Apr 1993. 122p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE93014855. Source: OSTI; NTIS; INIS; GPO Dep.

The Yucca Mountain Site Characterization Project Office (YMPO) of the Department of Energy's Office of Civilian Radioactive Waste

Management Program is conducting a broad range of studies to determine the suitability of Yucca Mountain, Nevada, as the site for a potential nuclear-waste repository. The potential repository horizon is in the unsaturated zone, well above the saturated rock units. The major advantages of unsaturated conditions are that container corrosion, waste-form leaching, and radionuclide transport mechanisms are minimized due to the lack of contact between liquid water and the waste package (WP). The design and performance of the WP and the engineered barrier system (EBS) will be dependent on the geomechanical, hydrologic, and geochemical conditions over time in the rock forming the near-field environment (NFE). Whereas the purpose of Vol. 1 of this report ("Technical Bases for EBS Design") is to provide technical information on the NFE that is needed for future repository design decisions, the purpose of this volume is to document the scientific and engineering data, models, and approaches that were used to gather that information, thus enabling scientists and engineers to determine the validity of the information provided in Vol. 1. This is of particular importance since there is only limited data and experience with these types of engineered systems, especially in unsaturated rock masses, and very little data or understanding of engineering system performance at the temperatures that will likely result from waste emplacement. It is important, therefore, to have an understanding of the physical processes (a mechanistic understanding) in addition to the statistical distributions of the environmental conditions. This volume consists of eight sections divided by area of study, and a final section summarizing the results of field tests performed at G-Tunnel at the Nevada Test Site (NTS) near Yucca Mountain.

23057 (USGS-OFR–92-572) **Assessment of geophysical logs from borehole USW G-2, Yucca Mountain, Nevada.** Nelson, P.H. (Geological Survey, Denver, CO (United States)); Schimschal, U. Geological Survey, Denver, CO (United States). 1993. 34p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AI08-92NV10874. Order Number DE93013189. Source: OSTI; NTIS; INIS; GPO; U.S. Geological Survey, Books and Open File Reports Section, Federal Center, Box 25425, Denver, CO 80225; GPO Dep.

Commercial logging contractors, Western Atlas, Schlumberger, and Edcon obtained borehole geophysical logs at the site of a potential high level nuclear waste repository at Yucca Mountain, Nevada. Drill hole USW-G2 was picked for this test of suitable logging tools and logging technology, both representing state-of-the-art technology by these commercial companies. Experience gained by analysis of existing core data and a variety of logs obtained earlier by Birdwell and Dresser Atlas served as a guide to a choice of logs to be obtained. Logs were obtained in water-filled borehole in zeolitized tuff (saturated zone) and in air-filled borehole largely in unaltered welded tuff (unsaturated zone).

23058 (WHC-EP–0617-Draft) **Tank waste decision analysis report: Draft.** Johnson, M.E. (Westinghouse Hanford Co., Richland, WA (United States)); Grygiel, M.L.; Baynes, P.A.; Bekemeier, J.P.; Zimmerman, B.D.; Triplett, M.B. Westinghouse Hanford Co., Richland, WA (United States). 31 Mar 1993. 188p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE93011903. Source: OSTI; NTIS; INIS; GPO Dep.

The Assistant Secretary for Environmental Restoration and Waste Management and the director of the Washington State Department of Ecology agreed to the need to re-evaluate treatment and disposal plans for Hanford Site tank waste. Re-evaluation of the tank waste treatment and disposal plans (referred to as re-baselining) was necessary to (1) provide an integrated system approach for achieving safe storage, (2) resolve tank safety issues, and (3) treat and dispose of all Hanford Site tank waste. Re-baselining evaluated new approaches to remediate Hanford Site tank waste and, thus, reaffirm existing plans or recommend a new technical strategy. To facilitate this integrated system approach for managing the program elements, the US Department of Energy formed the Tank Waste Remediation System (TWRS). While conducting this re-evaluation, the US Department of Energy agreed to continue supporting the existing plan for treatment and disposal of Hanford Site tank waste. The selection of a proposed new technical strategy for the TWRS Program is a complex task involving the evaluation of a large body of data. The data that is available to support the selection of a proposed new technical strategy is based on engineering estimates and preliminary technology development. To accommodate this complex, dynamic situation, a systems engineering approach is being applied to structure and analyze technical strategies and to manage the TWRS Program. Systems engineering is a generalized and systematic methodology for defining problems, evaluating solutions, and implementing the solutions. This report describes the development of the TWRS Program systems engineering analysis, the analytical methodologies that support it, and the results of the analyses that were used to define the proposed new technical strategy.

23059 (WHC-SA–1544) **Hanford Waste Vitrification Project Building limited scope risk assessment.** Braun, D.J.; Lindberg, S.E.; Reardon, M.F.; Wilson, G.P. Westinghouse Hanford Co., Richland, WA (United States). Oct 1992. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. (CONF-930116–45: Probabilistic safety assessment international topical meeting (PSA 93), Clearwater Beach, FL (United States), 27-29 Jan 1993). Order Number DE93011357. Source: OSTI; NTIS; INIS; GPO Dep.

A limited scope risk assessment was performed on the preliminary design of a high-level waste interim storage facility. The Canister Storage Building (CSB) facility will be built to support remediation at the US Department of Energy Hanford Site in Washington State. The CSB will be part of the support facilities for a high level Hanford Waste Vitrification Plant (HWVP). The limited scope risk assessment is based on a preliminary design which uses forced air circulation systems to move air through the building vault. The current building design calls for natural circulation to move air through the building vault.

23060 (WHC-SA–1698) **Safety analysis and inventory control of transuranic and low-level waste in common storage.** Porten, D.R.; Bonner, A.L.; Joyce, J.P. Westinghouse Hanford Co., Richland, WA (United States). Jan 1993. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. (CONF-930204–2: '93 meeting on waste management, Tucson, AZ (United States), 28 Feb - 4 mar 1993). Order Number DE93011282. Source: OSTI; NTIS; INIS; GPO Dep.

This paper describes a methodology developed For the inventory control of low-level waste (LLW) and transuranic (TRU) waste, when both are stored in the same location, and both contribute to an inventory constrained by safety considerations. Development of the method arose from the necessity to make safety analysis calculations for the addition of LLW, in quantities greater than existing inventory limits would allow when stored with TRU waste, in the Hanford Central Waste Complex (CWC)-Ensuring that the dose consequences of credible releases are maintained at low-hazard limits or less, was used to allow greater than Type A quantities of LLW into the CWC. Basically, what happens is the original limited amount of TRU allowed is reduced by some equivalent amount of LLW introduced. The total quantity of TRU, and LLW in excess of Type A quantities, must be administratively maintained via curie equivalency Factors to ensure operation as a low-hazard Facility. The "equivalency" between TRU and LLW proposed here is specific only to the CWC, but the methodology can be used for other specific applications, such as TRU and LLW storage or handling facilities where inventory limits must be enforced or where a simplified inventory system is required.

23061 (WHC-SA–1723) **Computer simulation of the thermal history of a Hanford Site high heat load waste tank.** Bander, T.J. (Westinghouse Hanford Co., Richland, WA (United States)); McCall, T.B. Westinghouse Hanford Co., Richland, WA (United States). Jan 1993. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. (CONF-930395–4: Computer simulation in waste management and environmental sciences, Washington, DC (United States), 29 Mar - 1 apr 1993). Order Number DE93011354. Source: OSTI; NTIS; INIS; GPO Dep.

This paper presents the results of a transient thermal analysis based on historical records of a high heat load single-shell tank of radioactive waste from United States weapons material processes. The thermally related information includes the following: waste material additions and extractions, recorded levels of both liquid and

sludge layers, total heat load for the tank, based upon: water additions, psychrometric measurements, and isotopic chemical makeup of sampled wastes thermocouple data in the air space, liquid layer, and sludge layers. This information was analyzed and evaluated to construct an approximate heat source in the tank as a function of time. A thermal model was developed for each consistent geometric configuration of the waste with boundary conditions and thermal input. Reasonably conservative assumptions were used in all aspects of the modeling. The boundary conditions were always selected to cause higher-than-expected temperatures in the transient analyses. The temperature distribution is shown for the time when maximum temperatures occur in the models. Also, temperature histories are shown for selected nodes in the models.

23062 (WHC-SA–1731) **Hanford Waste Vitrification Plant project overview and status.** Smets, J.L. (Fluor Daniel, Inc., Irvine, CA (United States)); Swenson, L.D. Westinghouse Hanford Co., Richland, WA (United States). Jan 1993. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. (CONF-930408–63: International high-level radioactive waste management conference, Las Vegas, NV (United States), 25-29 Apr 1993). Order Number DE93011252. Source: OSTI; NTIS; INIS; GPO Dep.

The Hanford Waste vitrification Plant (HWVP) is being constructed at the US Department of Energy's Hanford Site in Richland, Washington. Engineering and design are being accomplished by Fluor Daniel, Inc. in Irvine, California. Technical input is furnished by Westinghouse Hanford Company and construction management services by UE&C-Catalytic Inc.

23063 (WHC-SA–1733) **The Hanford Waste Vitrification Plant shielding design: A historical perspective.** Fortsch, M. (Fluor Daniel, Inc., Las Vegas, NV (United States)); Negin, C. Westinghouse Hanford Co., Richland, WA (United States). Jan 1993. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. (CONF-930408–64: International high-level radioactive waste management conference, Las Vegas, NV (United States), 25-29 Apr 1993). Order Number DE93011280. Source: OSTI; NTIS; INIS; GPO Dep.

The shielding design Of the Hanford Waste Vitrification Plant (HWVP) has been underway for many years and is continuing. During its progress, there have been improvements in various calculational methods that provided practical guidance to the overall design activities and established the shielding requirements for the facility. This paper demonstrates how these changing and improving methods were implemented. It also historically describes the development of the methods themselves.

23064 (WHC-SA–1738) **Mechanical design of the storage tubes in the Hanford Waste Vitrification Plant Canister Storage Building.** Janicek, G.P. (Westinghouse Hanford Co., Richland, WA (United States)); Mullally, J.A.; Divona, C.J.; Fages, R. Westinghouse Hanford Co., Richland, WA (United States). Jan 1993. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. (CONF-930408–66: International high-level radioactive waste management conference, Las Vegas, NV (United States), 25-29 Apr 1993). Order Number DE93011278. Source: OSTI; NTIS; INIS; GPO Dep.

High-level waste canisters from the Hanford Waste Vitrification Plant will be stored in an adjacent facility called the Canister Storage Building. The canisters are stored vertically in an array the tubes within the shielded vault area of the Canister Storage Building. The following discussion addresses the mechanical design of the storage tubes, the shield floor plugs that confine the waste within the tubes, the impact absorber system used to ensure that the canisters are not breached during an unintentional fall, and the installation and testing of components.

23065 (WHC-SA–1835) **Tank 241-CX-70 waste removal and packaging.** DuVon, D.K. Westinghouse Hanford Co., Richland, WA (United States). [1993]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. (CONF-9304128–10: Department of Energy (DOE) radiation protection conference, Las Vegas, NV (United States), 13-15 Apr 1993). Order Number DE93014624. Source: OSTI; NTIS; INIS; GPO Dep.

Tank 241-CX-70, located on the Hanford Site in Washington State, is a 30,000 gal single-shell storage tank built in 1952 to hold high-level process waste from pilot tests of the reduction-oxidation process. In 1979 decommissioning operations were begun by pumping liquid waste from the tank to the double-shell tank (DST) 101-AY. Not all the waste was removed at that time. Approximately 10,300 gal of sludge remained. On September 25, 1987, operations were resumed to remove the remaining waste using a sluicing and pumping method. This report documents the final removal of waste from Tank 241-CX-70.

23066 (WHC-SA–1921) **Summary of FY 1992 operations of the vapor extraction system at the Hanford Site, Washington.** Green, J.W.; Hand, R.L.; Johnson, W.L.; Millikin, E.J.; Rohay, V.J. Westinghouse Hanford Co., Richland, WA (United States). May 1993. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. (CONF-9304117–3: International waste management conference, San Juan (Puerto Rico), 28 Apr 1993). Order Number DE93013050. Source: OSTI; NTIS; INIS; GPO Dep.

The 200 West Area Carbon Tetrachloride Expedited Response Action is being conducted on the Hanford Site by the US Department of Energy at the direction of the US Environmental Protection Agency and the Washington State Department of Ecology. The Expedited Response Action was initiated based on concerns that carbon tetrachloride residing in soils beneath the 200 West Area from past disposal practices may be continuing to serve as a source for contamination of the groundwater. The method for removing the carbon tetrachloride includes utilization of soil vapor extraction from existing wells with above-ground collection of the carbon tetrachloride on granular activated carbon. The activated carbon is sent off-site for regeneration. This paper summarizes the operations and lessons learned for Fiscal Year 1992 and presents operational plans for FY 1993.

23067 (WHC-SP–0909) **Tri-party agreement milestone summary, September 1992.** Calapristi, F.T. Westinghouse Hanford Co., Richland, WA (United States). Sep 1992. 76p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE93011300. Source: OSTI; NTIS; INIS; GPO Dep.

Budgets and schedules pertaining to radioactive waste management at the Hanford Reservation are presented. Milestones, accomplishments and planned actions are included for treatment of tank shell waste, vitrification plant operations, remedial investigation studies for all operable units, closure plans, the WRAP facility, and other treatment facilities.

23068 (WHC-SP–1689) **Infrared imaging systems for the ferrocyanide waste tanks at the US Department of Energy's Hanford Site.** Mailhot, R.B.; Morris, K.L. Westinghouse Hanford Co., Richland, WA (United States). Feb 1993. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. (CONF-930204–3: '93 meeting on waste management, Tucson, AZ (United States), 28 Feb - 4 mar 1993). Order Number DE93011285. Source: OSTI; NTIS; INIS; GPO Dep.

The US Department of Energy's Hanford Site in Washington State has 24 radioactive storage tanks containing ferrocyanide. There is a concern that these tanks could become explosive. Infrared imaging was investigated as a method to determine if high-heat areas (i.e., "hot spots") exist in the tanks. A hot spot is defined as a volumetric region within a waste tank with an excessively warm [220°C (428°F)] temperature that is generated by radioactive isotopes. The thermal image of a hot spot was modeled by computer. This model determined the temperature variation an infrared system must detect. Laboratory and field tests of the imaging system are described and conclusions based on the laboratory data are presented. The report describes the system's capabilities and limitations. The infrared imaging system is able to detect the surface image of the modeled hot spot in most of the ferrocyanide tanks.

23069 (WSRC-MS–91-104-Rev.1) **The Product Composition Control System at Savannah River: The statistical process control algorithm: Revision 1.** Brown, K.G. Westinghouse

Savannah River Co., Aiken, SC (United States). [1993]. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. (CONF-930608–1-Rev.1: Safewaste '93: the final disposal of nuclear waste, Avignon (France), 14-18 Jun 1993). Order Number DE93011774. Source: OSTI; NTIS; INIS; GPO Dep.

The Defense Waste Processing Facility (DWPF) at the Savannah River Site (SRS) in Aiken, South Carolina, will be used to immobilize the approximately 130 million liters of high-level nuclear waste currently stored at the site in 51 carbon steel tanks. Waste handling operations separate this waste into highly radioactive insoluble sludge and precipitate and less radioactive water soluble salts. (In a separate facility, the soluble salts are disposed of as low-level waste in a mixture of cement, slag, and flyash.) In DWPF, precipitate (PHA) is blended with insoluble sludge and ground glass tit to produce melter feed slurry which is continuously fed to the DWPF melter. The melter produces a molten borosilicate glass which is poured into stainless steel canisters for cooling and, ultimately, shipment to and storage in a geologic repository. The repository requires that the glass wasteform be resistant to leaching by underground water that might contact it. In addition, there are processing constraints on melt viscosity, liquidus temperature, and waste solubility.

23070 (WSRC-MS–92-430) **Application of probabilistic risk assessment methods to incinerator design and permitting.** Brown, E.A. (Westinghouse Savannah River Co., Aiken, SC (United States)); McAfee, D.E.; Aabye, D.C. Westinghouse Savannah River Co., Aiken, SC (United States). 14 Feb 1993. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. (CONF-930572–2: 12. annual international symposium on thermal treatment technologies - incineration conference, Knoxville, TN (United States), 3-7 May 1993). Order Number DE93012140. Source: OSTI; NTIS; GPO Dep.

The Consolidated Incineration Facility at the Savannah River Site is designed without emergency flue gas vents. The main components of this 18 million btu/hr facility are a rotary kiln and secondary combustion chamber, each with a code allowable internal pressure of 15 psig. The facility is designed to treat mixed waste. During the early stages of design it was judged on a qualitative basis that potential eventsthat might produce damaging overpressures were not credible. When these findings were questioned during subsequent design reviews, a probabilistic risk assessment was undertaken to provide a quantitative basis for decision making. The result was identification of design conditions leading to relatively high frequencies for a few event sequences in which the allowable pressure might be exceeded. Risk assessment assumptions and results were reviewed with design engineers and relatively simple improvements were identified that collectively reduced the frequency of overpressure to an acceptable level. This experience showed that the use of formalized risk assessment techniques can provide valuable insight leading to timely and cost-effective improvements in facility design and operating procedures. In this case, the program of analysis and follow-on improvements provided justification for incinerator operation without thermal relief devices.

23071 (WSRC-MS–92-505) **Effects of temperature and radiation on the nuclear waste glass product consistency leach test.** Crawford, C.L.; Bibler, N.E. Westinghouse Savannah River Co., Aiken, SC (United States). [1993]. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. (CONF-930438–5: 95. annual meeting of the American Ceramic Society, Cincinnati, OH (United States), 18-22 Apr 1993). Order Number DE93011776. Source: OSTI; NTIS; INIS; GPO Dep.

Previous leach studies carried out with monolithic glass samples have shown that glass dissolution rates increase with increasing temperature and may or may not increase on exposure to external gamma radiolysis. In this study we have investigated the effects of temperature (70–1200°C) and radiation on the dissolution of simulated radioactive waste glasses using the Product Consistency Test (PCT). The PCT is a seven day, crushed glass leach test in deionized water that is carried out at 9OO°C. To date our results indicate no significant effect of external Co–60 gamma radiation when testing various simulated waste glasses at 90°C in a wellinsulated compartment within a Gammacell 220 irradiation unit. The temperature dependence for glass dissolution clearly exhibits Arrheniustype behavior for two of the three glasses tested. For the third glass the dissolution decreases at the higher temperatures, probably due to saturation effects. Actual radioactive waste glasses will be investigated later as part of this study.

23072 (WSRC-MS–93-143) **Code requirements for concrete repository and processing facilities.** Hookham, C.J. (Black & Veatch, Ann Arbor, MI (United States)); Palaniswamy, R. Westinghouse Savannah River Co., Aiken, SC (United States). [1993]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. (CONF-930408–62: International high-level radioactive waste management conference, Las Vegas, NV (United States), 25-29 Apr 1993). Order Number DE93010380. Source: OSTI; NTIS; INIS; GPO Dep.

The design and construction of facilities and structures for the processing and safe long-term storage of low- and high-level radioactive wastes will likely employ structural concrete. This concrete will be used for many purposes including structural support, shielding, and environmental protection. At the present time, there are no design costs, standards or guidelines for repositories, waste containers, or processing facilities. Recently, the design and construction guidelines contained in American Concrete Institute (ACI), Code Requirements for Nuclear Safety Related Concrete Structures (ACI 349), have been cited for low-level waste (LLW) repositories. Conceptual design of various high-level (HLW) repository surface structures have also cited the ACI 349 Code. However, the present Code was developed for nuclear power generating facilities and its application to radioactive waste repositories was not intended. For low and medium level radioactive wastes, concrete has a greater role and use in processing facilities, engineered barriers, and repository structures. Because of varied uses and performance/safety requirements this review of the current ACI 349 Code document was required to accommodate these special classes of structures.

23073 (WSRC-MS–93-204) **Simulation of radionuclides in the saturated zone at the E-Area low- level radioactive waste disposal facility, Savannah River Site.** Hiergesell, R.A. (Westinghouse Savannah River Co., Aiken, SC (United States)); Kearl, P.M. Westinghouse Savannah River Co., Aiken, SC (United States). [1993]. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. (CONF-9306158–3: 1993 groundwater modeling conference, Boulder, CO (United States), 6-12 Jun 1993). Order Number DE93013684. Source: OSTI; NTIS; INIS; GPO Dep.

Numerical simulation of migration of Technetium-99 and Tritium beneath a proposed low-level radioactive waste disposal facility at the Savannah River Site was conducted utilizing the Porflow code. These species were selected for preliminary analysis based upon screening exercises designed to identify species of concern and because each has contrasting properties in regard to adsorption and half-life. Numerous field data describing the three-layered aquifer system were utilized to set up the model and for comparison to simulated results to achieve calibration. Results of initial simulations indicate that contaminants migrate laterally toward discharge zones at local streams. Vertically the Technetium-99 plume reached the lowermost aquifer in one small area in the vicinity of the surface water discharge zone. Maximum simulated radionuclide concentrations were reached at different times and locations but were both below levels that would pose a health threat to either the general public or inadvertent intruders.

23074 (WSRC-MS–93-207) **Treatment of mixed F006 contaminated material to meet the new EPA debris rule at the Savannah River Site.** Pickett, J.B.; Diener, G.A.; Carroll, S.J.; Steingard, J.M. Westinghouse Savannah River Co., Aiken, SC (United States). [1993]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. (CONF-930873–13: 2. international mixed waste symposium, Baltimore, MD (United States), 17-20 Aug 1993). Order Number DE93013828. Source: OSTI; NTIS; INIS; GPO Dep.

The Westinghouse Savannah River Company (WSRC), as the operating contractor for the Department of Energy (DOE) at the Savannah River Site (SRS) has demonstrated a procedure to clean mixed (radioactive/hazardous) materials to meet the criteria in the recently promulgated Land Disposal Restrictions "debris" rule. The

material was equipment (steel piping, transfer pumps valves) which had been used in industrial wastewater treatment facility to transfer listed F006 wastewater treatment plating line sludges to a RCRA storage tank complex. When the equipment needed to be replaced/repaired, it was concluded that the resulting debris would have to be managed as a mixed waste, due to the fact that the solid waste "contained" the listed hazardous waste.

23075 (WSRC-MS–93-217) **Regulatory issues in vitrification research: A case study of circuit board reclamation.** Bickford, D.F. (Westinghouse Savannah River Co., Aiken, SC (United States)); Compton, K.L.; Bennert, D.M. Westinghouse Savannah River Co., Aiken, SC (United States); Clemson Univ., SC (United States). Dept. of Environmental Systems Engineering. [1993]. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. (CONF-930438–17: 95. annual meeting of the American Ceramic Society, Cincinnati, OH (United States), 18-22 Apr 1993). Order Number DE93012796. Source: OSTI; NTIS; INIS; GPO Dep.

Vitrification has shown great potential as a method of remediation, as it incorporates aspects of all of the fundamental treatment techniques of destruction, extraction, and immobilization. A wide variety of waste streams can be treated to levels acceptable for disposal in municipal solid waste landfills. However, it is important that an individual considering vitrification as a treatment method understands the regulatory mechanism whereby a vitrified waste may be disposed of in a Subtitle D (i.e. non-hazardous) land disposal facility. This presentation is designed to orient the individual to the current RCRA requirements for land disposal of vitrified waste residues.

23076 (WSRC-RP–89-261) **Combustibility of tetraphenylborate solids.** Walker, D.D. Westinghouse Savannah River Co., Aiken, SC (United States). 3 May 1989. 38p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE93013577. Source: OSTI; NTIS; INIS; GPO Dep.

Liquid slurries expected under normal in-tank processing (ITP) operations are not ignitible because of their high water content. However, deposits of dry solids from the slurries are combustible and produce dense, black smoke when burned. The dry solids burn similarly to Styrofoam and more easily than sawdust. It is the opinion of fire hazard experts that a benzene vapor deflagration could ignite the dry solids. A tetraphenylborate solids fire will rapidly plug the waste tank HEPA ventilation filters due to the nature of the smoke produced. To prevent ignition and combustion of these solids, the waste tanks have been equipped with a nitrogen inerting system.

23077 (WSRC-RP–90-359-Rev.1) **Canister disposition plan for the DWPF Startup Test Program: Revision 1.** Harbour, J.R.; Payne, C.H. Westinghouse Savannah River Co., Aiken, SC (United States). [1990]. 40p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE93012822. Source: OSTI; NTIS; INIS; GPO Dep.

This report details the disposition of canisters and the canistered waste forms produced during the DWPF Startup Test Program. The six melter campaigns (DWPF Startup Tests FA-13, WP-14, WP-15, WP-16, WP-17, and FA-18) will produce 126 canistered waste forms. In addition, up to 20 additional canistered waste forms may be produced from glass poured during the transition between campaigns. In particular, this canister disposition plan (1) assigns (by alpha-numeric code) a specific canister to each location in the six campaign sequences, (2) describes the method of access for glass sampling on each canistered waste form, (3) describes the nature of the specific tests which will be carried out, (4) details which tests will be carried out on each canistered waste form, (5) provides the sequence of these tests for each canistered waste form, and (6) assigns a storage location for each canistered waste form. The tests are designed to provide evidence, as detailed in the Waste Form Compliance Plan (WCP[1]), that the DWPF product will comply with the Waste Acceptance Product Specifications (WAPS[2]). The WAPS must be met before the canistered waste form is accepted by DOE for ultimate disposal at the Federal Repository. The results of these tests will be included in the Waste Form Qualification Report (WQR).

23078 (WSRC-RP–90-522) **Backpulse and filter feed velocity effects on Norton filter performance.** Siler, J.L. Westinghouse Savannah River Co., Aiken, SC (United States). 8 May 1990. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE93011785. Source: OSTI; NTIS; INIS; GPO Dep.

A series of tests have been conducted using the 2.2 ft^2 Norton filter to solve the fouling problems observed with the ETF Norton system. The objective of these tests was to determine filter efficiency as a function of backpulse strength and feed velocity. Based on experimental results, it is recommend that the filters should be operated at the following conditions: (1) Backpulse Transmembrane Pressure/FeedTransmembrane Pressure (BP/FP) > 1.5, preferably 2 or 3. (2) Feed crossflow velocity = 6–8 f/s. It is expected that operation at these conditions should improve performance by 30–60%.

23079 (WSRC-RP–93-227) **Lead macro-encapsulation conceptual and experimental studies: Final report.** Orebaugh, E.G. Westinghouse Savannah River Co., Aiken, SC (United States). 31 Jan 1993. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE93012137. Source: OSTI; NTIS; INIS; GPO Dep.

Macro-encapsulation, the regulatory treatment for radioactively contaminated lead (mixed) waste has been conceptually and experimentally evaluated for practical application. Epoxy encapsulants molded around lead billets have proven to be exceptionally rugged, easily applied, have high radiation and chemical stability, and minimize required process equipment and production of secondary wastes. This technology can now be considered developed, and can be applied as discussed in this report.

23080 (WSRC-RP–93-381) **Code-to-code benchmarking of SPEEDUP™ versus WATFAM.** Gregory, M.V. Westinghouse Savannah River Co., Aiken, SC (United States). Mar 1993. 30p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE93013579. Source: OSTI; NTIS; GPO Dep.

SPEEDUP™ is a state-of-the-art, dynamic, chemical process modeling package offered by Aspen Technology. In anticipation of new customers needs for new analytical tools to support the site's waste management activities, SRTC has secured a multiple-user license to SPEEDUP™. In order to verify the modeling constructs in SPEEDUP™, identical representations of the 2H Evaporator system were set up in SPEEDUP™ and the current tank farm model WATFAM. These calculations augment earlier work on numerical benchmarking in establishing an on-site quality assurance pedigree for Speedup™. The dynamic response of the 2H Evaporator system (comprising of the evaporator itself, the evaporator feed Tank 43, the concentrate receipt Tank 38, the supernate recycle between Tanks 38 and 43, and the evaporator overhead) was tracked through a typical 50 day scenario. The initial and boundary conditions for both the SPEEDUP™ and WATFAM representations were defined identically. The recycle control algorithms were defined very differently for the two models, as required by the two different language constructs, SPEEDUP™ versus FORTRAN. During those intervals of time when the recycle dynamics in the two models could be constrained consistently (i.e., during the initial 40 days), the responses of the two codes were in excellent agreement. This constitutes a validation of the modeling constructs in SPEEDUP™ versus WATFAM, and vice versa.

23081 (WSRC-TR–92-121-Rev.1) **Projected radionuclide inventories of DWPF glass from current waste at time of production: Revision 1.** Plodinec, M.J. Westinghouse Savannah River Co., Aiken, SC (United States). 4 Feb 1993. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE93013573. Source: OSTI; NTIS; INIS; GPO Dep.

The Waste Acceptance Preliminary Specifications (WAPS) require that the DWPF estimate the inventory of long-lived radionuclides present in the waste glass, and report the values in the Waste Form Qualification Report. In this report, conservative (biased high) estimates of the radionuclide inventory of glass produced from waste currently in the Tank Farm are provided. In most cases, these calculated values compare favorably with actual data.

In those cases where the agreement is not good, the values reported here are conservative.

23082 (WSRC-TR–92-569) **Lot No. 1 of Frit 202 for DWPF cold runs.** Schumacher, R.F. Westinghouse Savannah River Co., Aiken, SC (United States). 1 Apr 1993. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE93013571. Source: OSTI; NTIS; INIS; GPO Dep.

This report was prepared at the end of 1992 and summarizes the evaluation of the first lot sample of DWPF Frit 202 from Cataphote Inc. Publication of this report was delayed until the results from the carbon analyses could be included. To avoid confusion the frit specifications presented in this report were those available at the end of 1992. The specifications were slightly modified early in 1993. The frit was received and evaluated for moisture, particle size distribution, organic-inorganic carbon and chemical composition. Moisture content and particle size distribution were determined on a representative sample at SRTC. These properties were within the DWPF specifications for Frit 202. A representative sample was submitted to Corning Engineering Laboratory Services for chemical analyses. The sample was split and two dissolutions prepared. Each dissolution was analyzed on two separate days. The results indicate that there is a high probability (>95%) that the silica content of this frit is below the specification limit of 77.0 ± 1.0 wt %. The average of the four analyzed values was 75.1 wt % with a standard deviation of 0.28 wt %. All other oxides were within the elliptical two sigma limits. Control standard frit samples were submitted and analyzed at the same time and the results were very similar to previous analyses of these materials.

23083 (WSRC-TR–93-010) **Canyon building ventilation system dynamic model – Parameters and validation.** Moncrief, B.R. (Westinghouse Savannah River Co., Aiken, SC (United States)); Chen, F.F.K. Westinghouse Savannah River Co., Aiken, SC (United States). [1993]. 27p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. (CONF-930862–1: 1993 American Society of Mechanical Engineers (ASME) international computers in engineering conference and exposition, San Diego, CA (United States), 8-12 Aug 1993). Order Number DE93007633. Source: OSTI; NTIS; GPO Dep.

Plant system simulation crosses many disciplines. At the core is the mimic of key components in the form of mathematical "models." These component models are functionally integrated to represent the plant. With today's low cost high capacity computers, the whole plant can be truly and effectively reproduced in a computer model. Dynamic simulation has its roots in "single loop" design, which is still a common objective in the employment of simulation. The other common objectives are the ability to preview plant operation, to anticipate problem areas, and to test the impact of design options. As plant system complexity increases and our ability to simulate the entire plant grows, the objective to optimize plant system design becomes practical. This shift in objectives from problem avoidance to total optimization by far offers the most rewarding potential. Even a small reduction in bulk materials and space can sufficiently justify the application of this technology. Furthermore, to realize an optimal plant starts from a tight and disciplined design. We believe the assurance required to execute such a design strategy can partly be derived from a plant model. This paper reports on the application of a dynamic model to evaluate the capacity of an existing production plant ventilation system. This study met the practical objectives of capacity evaluation under present and future conditions, and under normal and accidental situations. More importantly, the description of this application, in its methods and its utility, aims to validate the technology of dynamic simulation in the environment of plant system design and safe operation.

23084 (WSRC-TR–93-078) **Investigation of the corrosion behavior of cooling coil material in a simulated concrete environment.** Wiersma, B.J. Westinghouse Savannah River Co., Aiken, SC (United States). 1 Feb 1993. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE93012821. Source: OSTI; NTIS; INIS; GPO Dep.

Pitting corrosion of the cooling coils embedded in the concrete roof of the waste tanks is one of the suspected causes of the recent cooling coil failures. Cyclic polarization tests were conducted to predict the threshold chloride level above which pitting would initiate. The threshold chloride level was determined to be 9000 ppM. Although these tests predict the electrochemical or corrosion behavior of the metal, they may not predict the severity of attack. Further tests which investigate the effect of the permeability of the concrete matrix on the transport of water and oxygen to the metal surface are planned to assess the severity of attack.

23085 (WSRC-TR–93-172) **662-E solid waste silo-plug lifting analysis.** Mertz, G.E. Westinghouse Savannah River Co., Aiken, SC (United States). Mar 1993. 34p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. (SRT-EMT–93-1035). Order Number DE93014728. Source: OSTI; NTIS; INIS; GPO Dep.

The Intermediate Level Tritium Vault No. 1, 662-E, Cell No. 1 contains 140 waste silos. Each silo is approximately 25 feet deep, 30 inches in diameter at the top and covered by a reinforced concrete plug. Two No. 4 reinforcing bars project from the top of each plug for lifting. During lifting operations, the 1.5 inch concrete cover over the lifting bars spelled off 16% of the silo plugs. The No. 4 reinforcing bars were also distorted on many of the silo plugs. Thirteen of the plugs have been repaired to date. The existing silo plug lifting bars have a safe working load of 480 pounds per plug, which is less than 1/3 of the dead weight of the silo plug. The safe working load was calculated using the minimum design factor of 3 based on the yield strength or 5 based on the ultimate strength of the material, as per the Savannah River Site Hoisting and Rigging Manual. The existing design calculations were reviewed, and the following items are noted: (1) Adequate concrete cover was not provided over the horizontal portion of the lifting bars. (2) The lifting bars were allowed to yield in bending, which violates the requirements of the Savannah River Site Hoisting and Rigging Manual. (3) The ultimate strain of the lifting bars would be exceeded before the calculated ultimate strength was achieved. Alternative lifting devices are also identified.

0530 Environmental Aspects

Refer also to citation(s) 22933, 22957, 23127, 23129, 23544, 24122, 24728, 24729, 24732, 24733, 24734, 24735, 24736, 24737, 24771, 24831, 24908

23086 (DOE/FTR–93010294) **[Technical interchange with scientists from the two Russian weapons institutes, Arzamas-16 and Chelyabinsk-70 for environmental research]: Foreign trip report, October 2–11, 1992.** Hunter, T.O. (Sandia National Labs., Albuquerque, NM (United States)); Costin, L.S.; Brown, N.E.; Lapp, M. Sandia National Labs., Albuquerque, NM (United States). 4 Jan 1993. 135p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DR00789 ;AC04-76DP00789. Order Number DE93010294. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Discussions between Russian scientists from Arzamas-16 and Chelyabinsk-70 and a delegation of US scientists from the three weapons labs, SNL, LANL, and LLNL, were held over four days. The discussion sessions focused on various technical areas within the broad topic of environmental protection. Specific topics included: data acquisition from air, water, and soil sampling; field and laboratory analysis methods; remote sensing techniques and instrumentation; data base creation and use; public health investigations; mathematical modeling of contamination transport; and remediation technologies. Several sessions focused on a better understanding of the problems in the Chelyabinsk region created by the Russian nuclear weapons production and the current efforts to develop technology to deal with the problems. As a result of this interchange, 24 topics were identified that could be pursued iii cooperative efforts. Of these 24 topics, 12 were identified as having sufficient mutual interest that proposals to the International Science and Technology Center should be developed. Working together in smaller groups, one-page summary proposals were developed for the 12 topics. These proposals identified a lead contact for both the Russian and US groups, who will pursue further developmental efforts.

23087 (INIS-mf–13518) **The mining town of Pribram in science and technology. Abstracts of contributions.** 1992. [76p.] (In Czech). (CONF-9210351–: The mining town of Pribram in science and technology, Pribram (Czechoslovakia), 12-14 Oct 1992). Order Number DE93625342. Source: OSTI; NTIS (US Sales Only); INIS.

The publication contains 125 abstracts of contributions presented at the conference, out of which 16 have been inputted in INIS. These primarily deal with uranium mining problems, although topics such as the irradiation of crystals, economic problems of coal mining, and spent fuel storage in the Slovak Republic are also included. Uranium ore is mined in the Czech Republic at various sites, using conventional mining as well as extraction by leaching. The environmental impacts of such activities and their contribution to population exposure are discussed. Attention is also paid to the future land reclamation at tailing dumping grounds. (M.D.).

23088 (INIS-mf–13518, pp. Z16) **Principles and methodology of land reclamation at abandoned uranium tailings grounds.** Novotny, J. (Interprojekt Praha (Czechoslovakia)). 1992. [76p.] (In Czech). (CONF-9210351–: The mining town of Pribram in science and technology, Pribram (Czechoslovakia), 12-14 Oct 1992). In *The mining town of Pribram in science and technology. Abstracts of contributions.* Order Number DE93625342. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. TAILINGS/land reclamation; CONTAMINATION; ENVIRONMENTAL IMPACTS; ORE PROCESSING; RADIATION HAZARDS; TAILINGS; URANIUM ORES

23089 (INIS-mf–13518, pp. Z22) **Respecting regional ecology when launching uranium mines in the western Moravia region.** Slovak, J. (DIAMO, o.z. Ekologie, Straz pod Ralskem (Czechoslovakia)). 1992. [76p.] (In Czech). (CONF-9210351–: The mining town of Pribram in science and technology, Pribram (Czechoslovakia), 12-14 Oct 1992). In *The mining town of Pribram in science and technology. Abstracts of contributions.* Order Number DE93625342. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. URANIUM MINES/environmental impacts; CONTAMINATION; GROUND WATER; LAND RECLAMATION; ORE PROCESSING; RADIATION HAZARDS; SURFACE WATERS; URANIUM ORES

23090 (INIS-mf–13518, pp. LJ8) **Feasibility of high level radioactive waste storage and disposal in geologic structures of Slovakia.** Knesl, J. (Geologicky Prieskum, s.p. Spisska Nova Ves (Czechoslovakia)); Lukaj, M. 1992. [76p.] (In Czech). (CONF-9210351–: The mining town of Pribram in science and technology, Pribram (Czechoslovakia), 12-14 Oct 1992). In *The mining town of Pribram in science and technology. Abstracts of contributions.* Order Number DE93625342. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. RADIOACTIVE WASTE DISPOSAL/site selection; RADIOACTIVE WASTES; SLOVAK REPUBLIC

23091 (ORNL–6623) **Radiological survey results for the Peek Street site properties, Schenectady, New York.** Foley, R.D.; Cottrell, W.D.; Carrier, R.F. Oak Ridge National Lab., TN (United States). Aug 1992. 144p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93008239. Source: OSTI; NTIS; INIS; GPO Dep.

The Peek Street Industrial Facility, located at 425 Peek Street, Schenectady, New York, was operated by the General Electric Company for the Atomic Energy Commission (AEC) between 1947 and 1955. A variety of operations using radioactive materials were conducted at the site, but the main activities were to design an intermediate breeder reactor and to develop a chemical process for the recovery of uranium and plutonium from spent reactor fuel. Nonradioactive beryllium metal was machined on the site for breeder reactor application. The 4.5-acre site was decommissioned and released in October 1955. A radiological survey was conducted by Oak Ridge National Laboratory in November 1989. The survey included scan and grid point measurements of direct radiation levels outdoors on the five properties and inside the factory building, and radionuclide analysis of samples collected from each property. Radionuclide concentrations were determined in outdoor surface and subsurface soil samples from each property and in dust, debris, and structural materials from inside the factory building. Auger holes were logged to assess location and extent of possible subsurface residual soil radioactivity. Radionuclide concentrations were deter-mined in both indoor and outdoor water samples and in selected samples of vegetation. The presence of fixed and transferable surface residual radioactivity was investigated inside the factory building and on discarded materials outdoors on the property. High-volume air samples as well as additional selected indoor and outdoor soil samples were analyzed to determine levels of elemental beryllium.

23092 (ORNL/M–2563) **Biological Monitoring and Abatement Program for the Oak Ridge K-25 Site.** Kszos, L.A. (Oak Ridge K-25 Site, TN (United States)); Adams, S.M.; Ashwood, T.L.; Blaylock, B.G.; Greeley, M.S.; Loar, J.M.; Peterson, M.J.; Ryon, M.G.; Smith, J.G.; Southworth, G.R.; Shoemaker, B.A.; Hinzman, R.L. Oak Ridge K-25 Site, TN (United States). Feb 1993. 51p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OT21400. (K/EM–24/R1). Order Number DE93008487. Source: OSTI; NTIS; INIS; GPO Dep.

Environmental Sciences Division, Oak Ridge National Laboratory Publication No. 4009.

A proposed Biological Monitoring and Abatement Program (BMAP) for the Oak Ridge K-25 Site was prepared in December 1992 as required by the renewed National Pollutant Discharge Elimination System permit that was issued on October 1, 1992. The proposed BMAP consists of four tasks that reflect different but complementary approaches to evaluating the effects of K-25 Site effluents on the ecological integrity of Mitchell Branch, Poplar Creek, and the Poplar Creek embayment of the Clinch River. These tasks include (1) ambient toxicity monitoring, (2) bioaccumulation monitoring, (3) assessment of fish health, and (4) instream monitoring of biological communities. This overall BMAP plan combines established protocols with current biological monitoring techniques to assess environmental compliance and quantify ecological recovery. The BMAP will also determine whether the effluent limits established for the K-25 Site protect the designated use of the receiving streams (Mitchell Branch, Poplar Creek, and Clinch River) for growth and propagation of fish and other aquatic life. Results obtained from this biological monitoring program will also be used to document the ecological effects (and effectiveness) of remedial actions.

23093 (PNL–8531) **Columbia River monitoring: Distribution of tritium in Columbia River water at the Richland Pumphouse.** Dirkes, R.L. Pacific Northwest Lab., Richland, WA (United States). Feb 1993. 99p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93011019. Source: OSTI; NTIS; GPO Dep.

The Surface Environmental Surveillance Project (SESP) is conducted by the Pacific Northwest Laboratory (PNL) for the US Department of Energy (DOE). This report presents the results of a special study conducted as part of the SESP to supplement the routine Columbia River monitoring program and provide information relative to the dispersion and distribution of Hanford origin contaminants entering the river through the seepage of ground water along the Hanford Site. Sampling was conducted along cross sections to determine the distribution of tritium within the Columbia River at Richland, Washington. The investigation was also designed to evaluate the relationship between the average tritium concentrations in the river water at this location and in water collected from the routine SESP river monitoring system located at the city of Richland drinking water intake (Richland Pumphouse). This study was conducted during the summers of 1987 and 1988. Water samples were collected along cross sections located at or near the Richland Pumphouse monitoring station.

0540 Health and Safety

Refer also to citation(s) 22887, 22898, 22909, 22913, 22914, 22915, 22927, 22930, 22953, 23024, 23026, 23030, 23045, 23046, 23047, 23059, 23060, 23064, 23066, 23068, 23639, 23648, 23725, 23743, 24151, 24152, 24175, 24434, 24567, 24706, 24707, 24709, 24713, 24714, 24715, 24716, 24766, 24772, 24784, 24785, 24889, 24903, 24911, 24914, 24915, 24946

23094 (ANL/EAIS/TM–79) **Modeling groundwater flow at the chemical plant area of the Weldon Spring Site.** Durham, L.A. Argonne National Lab., IL (United States). Environmental Assessment and Information Sciences Div. Oct 1992. 72p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. Order Number DE93009610. Source: OSTI; NTIS; INIS; GPO Dep.

Groundwater flow in the shallow unconfined aquifer at the chemical plant area of the Weldon Spring site, St. Charles County, Missouri, was modeled with the Coupled Fluid, Energy, and Solute Transport (CFEST) groundwater flow and contaminant transport computer code. The modeling was performed in support of a hydrogeological characterization effort that is part of the remedial investigation/feasibility study-environmental impact statement process being carried out by the US Department of Energy at the site. This report presents the results of model development and calibration. In the calibration procedure, the range of field-measured hydrogeological parameters was tested to obtain the best match between model-predicted and measured groundwater elevations. After calibration, the model was used to evaluate whether the presence of an on-site disposal cell would impact the ability to remediate contaminated groundwater beneath the cell. The results of the numerical modeling, which were based on an evaluation of steady-state groundwater flow velocity plots, indicated that groundwater would flow beneath the disposal cell along natural gradients. The presence of a disposal cell would not significantly affect remediation capability for groundwater contamination.

23095 (CONF-920791–, pp. 3, Paper 1) **Overview of EM Small Business Technology Integration Program.** Paladino, J. (Dept. of Energy, Washington, DC (US)). USDOE Assistant Secretary for Environmental Restoration and Waste Management, Washington, DC (United States). Jul 1992. From Information exchange meeting on characterization sensors and monitoring technologies; Dallas, TX (United States); 15-16 Jul 1992. In *Proceedings of the information exchange meeting on characterization, sensors, and monitoring technologies.* 261p. Order Number DE93005318. Source: OSTI; NTIS.

The Environmental Management Small Business Technology Integration Program (EM SB-TIP) seeks the participation of small technology development businesses with less than 500 employees in U.S. Department of Energy (DOE) environmental restoration and waste management research, development, demonstration, test, and evaluation (RDDT&E). The purpose of this small business program is to find, evaluate, and apply advanced, innovative technologies for in-situ remediation; groundwater and soils treatment; characterization, sensors, and monitoring; mixed waste processing; efficient separation techniques; robotics; and decontamination and decommissioning.

23096 (CONF-920791–, pp. 4, Paper 2) **Environmental management technology development overview.** Voelker, G. (Dept. of Energy, Washington, DC (US)). USDOE Assistant Secretary for Environmental Restoration and Waste Management, Washington, DC (United States). Jul 1992. From Information exchange meeting on characterization sensors and monitoring technologies; Dallas, TX (United States); 15-16 Jul 1992. In *Proceedings of the information exchange meeting on characterization, sensors, and monitoring technologies.* 261p. Order Number DE93005318. Source: OSTI; NTIS.

The U.S. Department of Energy (DOE) made a public commitment in 1989 to remediate more than 40 years of radioactive, hazardous, and mixed waste at its weapons production sites by 2019. The scope of the commitment is large: more than 3,700 sites and 26,000 acres of contaminated land awaiting remediation, over 500 surplus sites awaiting decontamination and decommissioning, and 5,000 peripheral sites with contaminated soil. DOE's Office of Environmental Restoration and Waste Management (EM), the organization overseeing DOE's environmental cleanup efforts, leads an aggressive, national, multibillion dollar research, development, demonstration, test, and evaluation (RDDT&E) program for cleaning up DOE weapons manufacturing sites. This technology development program delivers environmental restoration and waste management technologies better, faster, safer, and cheaper than those currently available. EM's environmental cleanup activities focus on two areas: environmental restoration to clean up DOE's sites and waste management to control and reduce the waste generated by DOE sites. EM's Office of Waste Operation is responsible for DOE's waste management activities, and EM's Office of Environmental Restoration focuses on DOE's environmental restoration efforts. EM's Office of Technology Development conducts the RDDT&E to develop innovative environmental restoration systems for the EM Offices of Waste Operations and Environmental Restoration when adequate technologies do not exist to meet DOE's environmental cleanup requirements.

23097 (CONF-920791–, pp. 9, Paper 3) **Characterization, monitoring and sensor technology for environmental restoration and waste management.** Roelant, D.; Purdy, C. USDOE Assistant Secretary for Environmental Restoration and Waste Management, Washington, DC (United States). Jul 1992. From Information exchange meeting on characterization sensors and monitoring technologies; Dallas, TX (United States); 15-16 Jul 1992. In *Proceedings of the information exchange meeting on characterization, sensors, and monitoring technologies.* 261p. Order Number DE93005318. Source: OSTI; NTIS.

To ensure that new and effective characterization, monitoring and sensor technologies (CMST) are provided to the Department of Energy (DOE) remediation efforts, DOE's Office of Technology Development within the Office of Environmental Restoration and Waste Management (EM) has established an Integrated Program (IP) on CMST. This CMST-IP focuses in the short-term on matching and adapting available CMST technologies to help solve EM problems at DOE sites. In the long-term, it aims to stimulate, coordinate and sponsor relevant research and development; and to promote and publicize available baseline CMST and developments of newly emerging technologies. Development of field-screening technologies by this IP will emphasize field-deployable instrumentation and noninvasive methods. Overall, the support of specific technology development will depend upon benefit to cost ratios, overall savings to EM, the development's link to Records of Decision at DOE sites, the critical nature of the need addressed, the ability of development to be utilized by multiple DOE sites and the degree to which the development represents an advance over baseline technologies. This paper discusses a variety of sensor technologies as well as the CMST-IP structure, efforts and current direction. The interaction of the CMST-IP with the Laboratory Management Division, Robotics Integrated Program, EMSL and other EM groups will also be addressed.

23098 (CONF-920791–, pp. 5, Paper 5) **Containerized mixed waste workshop tentatively scheduled: October, 1992.** Conway, S. (Colorado Center for Environmental Management, Golden (US)); Baldwin, C. USDOE Assistant Secretary for Environmental Restoration and Waste Management, Washington, DC (United States). Jul 1992. From Information exchange meeting on characterization sensors and monitoring technologies; Dallas, TX (United States); 15-16 Jul 1992. In *Proceedings of the information exchange meeting on characterization, sensors, and monitoring technologies.* 261p. Order Number DE93005318. Source: OSTI; NTIS.

In July 1991 the United States Department of Energy (DOE) awarded the Colorado Center for Environmental Management (CCEM) a five year grant to support its Technology/Regulatory Integration Project (TRIP). TRIP's goal is to develop and assess alternative ways for achieving effective citizen participation and timely regulatory review in the selection and implementation of innovative cleanup technologies for hazardous waste sites. CCEM is sponsoring this workshop to focus on the characterization of containerized mixed wastes. Participants will gain an overall understanding of the properties of these wastes and will develop strategies and techniques for the waste characterization as needed to meet regulatory and waste disposal site requirements and gain public acceptability. This effort will focus on containerized mixed waste throughout the DOE Complex rather than at any one site. The workshop will provide a national showcase for direct interaction among a broad array of technical, regulatory and public interests in addressing an important and timely DOE problem. In addition to technical experts within the DOE complex, the university community, and other organizations, the workshop will have active participation and input

from representatives of regulatory agencies, governmental and private disposal sites, local government, environmental organizations, and citizens' groups. The workshop should provide a snapshot of the state-of-the-art in techniques, technologies, and methods available to characterize containerized mixed waste. It will identify: gaps in the existing technical capabilities in characterization, priority R&D needs to fill those gaps, and areas where the university community and other technical experts can assist DOE (and possibly other federal agencies) by undertaking specific research initiatives related to the workshop's results.

23099 (CONF-920791–, pp. 4, Paper 11) **Cone penetrometer demonstration Westinghouse Hanford Company technology applications and testing.** Myers, D.R. USDOE Assistant Secretary for Environmental Restoration and Waste Management, Washington, DC (United States). Jul 1992. From Information exchange meeting on characterization sensors and monitoring technologies; Dallas, TX (United States); 15-16 Jul 1992. In *Proceedings of the information exchange meeting on characterization, sensors, and monitoring technologies.* 261p. Order Number DE93005318. Source: OSTI; NTIS.

The usefulness of cone penetrometer technology for performing in situ characterization of single shell tank (SST) wastes and in situ characterization of contaminated soil sites at the Hanford Site has received considerable speculation. The cone penetrometer demonstration is primarily a feasibility test to determine if a cone penetrometer can penetrate the salt cake in the SST wastes and the coarse, gravelly Hanford Site soils. Additional interests include the characterization of the tank wastes for physical, chemical, and radiological properties, and the characterization of Hanford Site soils for geologic structure, presence of contaminants, and hydrologic properties. Two separate feasibility testing efforts were carried out, one for the SST wastes and a second for the characterization of contaminated soil sites. The tank waste testing was carried out using simulated SST wastes composed of simulated salt cake and sludge. The simulated salt cake was made from Sulfur K Mag, a commercially available fertilizer, and the sludge was simulated with a bentonite slurry. Columns of simulated waste were made using 55-gal (208.2 L) barrels welded end to end, forming test columns 27 in. (68.6 cm) in diameter and 6.5 ft (2 m) high. The strength of the salt cake was controlled by changing the amount of water added to the Sulfur K Mag, and several different thicknesses, of simulated salt cake were placed in the test columns. The simulated sludge (bentonite slurry) was placed in the test columns first and the simulated salt cake was placed on top and allowed to harden. The test columns then were tested individually by placing them in a lined test pit, which had been dug into the ground to allow the cone penetrometer to be placed over the columns for the testing. The penetrometer was then advanced into each of the test columns while the cone and sleeve forces were recorded.

23100 (CONF-920791–, pp. 6, Paper 27) **Characterization of site geochemistry in support of environmental restoration.** Morris, D.E. (Los Alamos National Lab., NM (US)); Conradson, S.D.; Tait, C.D.; Chisholm-Brause, C.J.; Berg, J.M.; Musgrave, J. USDOE Assistant Secretary for Environmental Restoration and Waste Management, Washington, DC (United States). Jul 1992. From Information exchange meeting on characterization sensors and monitoring technologies; Dallas, TX (United States); 15-16 Jul 1992. In *Proceedings of the information exchange meeting on characterization, sensors, and monitoring technologies.* 261p. Order Number DE93005318. Source: OSTI; NTIS.

The objective of this task is to characterize the chemical speciation and physical properties of actinides and other toxic metals together with organic cocontaminants in contaminated soils at DOE facilities. The target information for chemical speciation will be the oxidation state of the metal, the chemical structure and stoichiometry of the metal complexes, and the binding mechanism(s) of the metal complexes to the soil substrates. The physical state of the metal complexes in the soils is also important. The authors will determine if they exist as surface precipitates, mineral coatings, and/or clay adsorbates. The chemical speciation and physical state of the actinides and toxic metals define the chemistry of these contaminants as they presently exist at the DOE sites. This information is made available to parties involved in devising and implementing remediation strategies so that appropriate, efficient, timely, and cost-effective remediation technologies will be brought to bear on the problem. Speciation characterization is also undertaken following the application of remediation technologies. This information is made available to parties involved with risk assessment so that judgments concerning the extent of decontamination and the long-term stability of any remaining contamination can be made and documented on the basis of sound chemical data. This task is presently funded by DOEs Office of Technology Development under the auspices of the Uranium in Soils Integrated Demonstration. The charge from the ID Coordinator is to focus on the speciation of uranium in contaminated soils at the Fernald Environmental Management Project site (formerly the Feed-Materials Production Center) in southwest Ohio. The results presented in this report specifically concern our work for this ID. However, the approach is generally valid for other actinides and many toxic metals that have the potential to exist in a variety of different chemical forms in the environment.

23101 (CONF-920791–, pp. 6, Paper 28) **Remote, real-time analysis of hazardous wastes through laser ablation - inductively coupled plasma atomic emission spectrometry.** D'Silva, A.P. (Ames Lab., IA (US)); Zamzow, D.; Jaselskis, E.; Baldwin, D.; Weeks, S. USDOE Assistant Secretary for Environmental Restoration and Waste Management, Washington, DC (United States). Jul 1992. From Information exchange meeting on characterization sensors and monitoring technologies; Dallas, TX (United States); 15-16 Jul 1992. In *Proceedings of the information exchange meeting on characterization, sensors, and monitoring technologies.* 261p. Order Number DE93005318. Source: OSTI; NTIS.

Field operable analytical systems that can provide data in real-time have a great advantage in that samples need not be collected, cataloged, transported, and stored prior to analysis; results can be obtained faster and more cost-effectively if the analyses can be done in the field. This is a particular advantage for samples that are radioactively contaminated. Minimizing the number of steps in the sample handling process minimizes the radiation exposure to workers; field sampling of radioactively contaminated materials can eliminate many of the concerns relating to storage and proper disposal after the analysis is completed. Also, on-site testing and analysis can provide data to determine whether remedial strategies and clean-up procedures are working. Ames Laboratory is developing a mobile analytical laboratory (mobile lab) designed to analyze radioactively contaminated soil samples using laser ablation (LA) and inductively coupled plasma atomic emission spectrometry (ICPAES). The soil surface is sampled by focusing laser radiation onto the soil; the ablated soil material is transported to an ICP for subsequent determination of the elemental composition of the soil based on the emission signals generated in the ICP and detected by the spectrometer. A robotic sampling system to enable sampling to be performed in highly radioactive environments is being incorporated into the system. The mobile lab will also have the capability of analyzing soil samples by subjecting them to a microwave digestion procedure for subsequent solution ICPAES determinations to be performed.

23102 (CONF-920791–, pp. 7, Paper 35) **The radiological and hazardous material measurement system (RHMMS).** Roney, T.J. (EG & G Idaho, Inc., Idaho Falls (US)); Johnson, L.O.; Klingler, T.B.; Karvinen, J.R.; McLaughlin, G.D.; Nieschmidt, E.B.; Shropshire, D.E. USDOE Assistant Secretary for Environmental Restoration and Waste Management, Washington, DC (United States). Jul 1992. From Information exchange meeting on characterization sensors and monitoring technologies; Dallas, TX (United States); 15-16 Jul 1992. In *Proceedings of the information exchange meeting on characterization, sensors, and monitoring technologies.* 261p. Order Number DE93005318. Source: OSTI; NTIS.

There is presently no system commercially available that will adequately identity and quantify uncharacterized transuranic(TRU)-contaminated wastes, either buried or containerized. Treatment facilities for TRU-contaminated wastes also need process control systems and final waste form assay systems capable of accurately measuring the TRU contamination levels at high measured volume throughput. Thus, the need exists for a system that will adequately

quantify transuranic waste, both retrieved and in fixed containers. For the reasons stated here, the development of the Radiological and Hazardous Material Measurement System (RHMMS) was initiated in 1989. This summary describes a system designed to quantify fissile and hazardous material for the remedial processes of retrieval, treatment, repackaging, transportation, and storage at a permanent site. Description of the technology and the need for the technology is given. The RHMMS concept of multiple measurements to reduce uncertainties in quantification is provided and contrasted with current assay systems.

23103 (CONF-920791–, pp. 6, Paper 36) **Mixed waste characterization strategy.** Baldwin, C.E. (EG & G Rocky Flats, Inc., Golden, CO (US)); Stakebake, J.; Peters, M. USDOE Assistant Secretary for Environmental Restoration and Waste Management, Washington, DC (United States). Jul 1992. From Information exchange meeting on characterization sensors and monitoring technologies; Dallas, TX (United States); 15-16 Jul 1992. In *Proceedings of the information exchange meeting on characterization, sensors, and monitoring technologies.* 261p. Order Number DE93005318. Source: OSTI; NTIS.

Radioactive mixed wastes containing a radioactive component subject to the Atomic Energy Act (AEA) and a hazardous waste subject to Resource Conservation and Recovery Act (RCRA) are generated, treated, and stored at the Rocky Flats Plant (RFP) and are subject to federal and state statutory and regulatory requirements. The U.S. Environmental Protection Agency (EPA) and the Colorado Department of Health (CDH) are the two primary regulatory agencies which enforce these requirements. This paper describes the mechanism by which RFP will characterize mixed wastes within the LDR provisions of RCRA and the LDR FFCA as well as for meeting the waste acceptance criteria for disposal.

23104 (CONF-920791–, pp. 6, Paper 37) **Nondestructive characterization of TRU and LLW mixed-wastes using active and passive gamma-ray spectrometry/computed tomography.** Camp, D.C. (Lawrence Livermore National Lab., CA (US)); Martz, H.E. USDOE Assistant Secretary for Environmental Restoration and Waste Management, Washington, DC (United States). Jul 1992. From Information exchange meeting on characterization sensors and monitoring technologies; Dallas, TX (United States); 15-16 Jul 1992. In *Proceedings of the information exchange meeting on characterization, sensors, and monitoring technologies.* 261p. Order Number DE93005318. Source: OSTI; NTIS.

The technology objective is to nondestructively characterize mixed wastes. This includes the localization, quantitation and identification of all detectable radioactivities within containerized waste. Once developed, the technology may also be able to identify heavy metals and non-volatile organic compounds within the waste container. The goal is to accurately quantitate all gamma-ray activity in wastes so that all waste types may be properly classified. More specifically, the authors are developing a prototype single, high-purity-germanium (1-HPGe), detector-based, contact-handled (CH), waste-drum scanner that uses gamma-ray spectrometry coupled with active (A) and passive (P) computed tomography (CT) to assay 208-L drums for their gamma-ray emitting radioisotopes. Once it is successfully demonstrated we will build a similar scanner will be built for Idaho National Engineering Laboratory. The ACT mode utilizes a highly collimated gamma-ray source to send a transmission beam though a drum. A collimated HPGe detector on the opposite side detects the attenuated gamma rays. If the attenuation is recorded as a function of translated and rotated drum positions, then an attenuation "map" of the waste-matrix is generated by well-known tomographic methods. Maps made at successive drum heights enable one to create three-dimensional (3-D) views of gamma-ray attenuations, which are related to atomic number and density variations within the waste matrix. Ratios of each drum slice or segment at different gamma-ray energies for a given drum height enable one to obtain effective-atomic-number and density information of the waste distribution.

23105 (CONF-920791–, pp. 9, Paper 38) **Contaminant analysis automation: Program overview.** Beugelsdijk, T.J. (Los Alamos National Lab., NM (US)). USDOE Assistant Secretary for Environmental Restoration and Waste Management, Washington, DC (United States). Jul 1992. From Information exchange meeting on characterization sensors and monitoring technologies; Dallas, TX (United States); 15-16 Jul 1992. In *Proceedings of the information exchange meeting on characterization, sensors, and monitoring technologies.* 261p. Order Number DE93005318. Source: OSTI; NTIS.

The environmental program, headed up by, Assistant Secretary Leo Duffy, thus become the fastest growing segment of the DOE In 1993, the DOE budget is projected at $19 billion, with about twenty five percent of that earmarked for environmental work. The largest share of the environmental budget is allocated to remediation contractors at the various DOE sites. However, several hundred million dollars are being devoted to the development of new technologies to aid in the cleanup process. This effort is being organized under the Office of Technology Development (OTD) within Leo Duffy's organization. The OTD charter is to effect the development of technologies that are currently unavailable. These technologies are to make the remediation effort proceed more quickly, more safely, and at a lower cost. included among the hundreds of technology development programs within the OTD, is a large robotics program. The effort was organized in the summer of 1989, starting with a site needs assessment. The needs assessment quickly focused the program on the major problems within DOE across the various sites and labs. These problems are summarized in Figure I and in the discussion below.

23106 (CONF-930396–9) **Implementation of in situ vitrification technology for remediation of Oak Ridge contaminated soil sites: Past results and future plans.** Tixier, J.S. (Pacific Northwest Lab., Richland, WA (United States)); Powell, T.D.; Spalding, B.P.; Jacobs, G.K. Oak Ridge National Lab., TN (United States). [1993]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400 ;AC06-76RL01830. From Waste management '93; Tucson, AZ (United States); 1-5 Mar 1993. Order Number DE93010335. Source: OSTI; NTIS; INIS; GPO Dep.

In situ vitrification is a thermal treatment technology being developed for remediation of contaminated soils. The process transforms easily leached, contaminated soils into a relatively inert, leach-resistant, vitreous and crystalline monolith. This paper presents the results of the recent highly successful ISV demonstration conducted jointly by PNL and ORNL on a tracer-level quantity of radioactive sludge in a model trench at ORNL. A retention of 90Sr in the vitreous and crystalline product of greater than 99.9999% was measured with a reduction in mobility of more than 2 orders of magnitude. The paper also presents the current plans for continued collaboration on a two setting treatability test on one portion of an old seepage pit at ORNL.

23107 (CONF-930769–3) **Advanced signal processing in geophysical remote sensing.** Witten, A.J. (Oak Ridge National Lab., TN (United States)); King, W.C. Oak Ridge National Lab., TN (United States). [1993]. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 1993 joint Canadian Society of Civil Engineers-American Society of Civil Engineers (CSCE-ASCE) national conference on environmental engineering; Montreal (Canada); 12-14 Jul 1993. Order Number DE93012753. Source: OSTI; NTIS; GPO Dep.

This paper describes advanced signal processing methods which have improved the capabilities to detect and image the subsurface environment with geophysical remote sensing techniques. Field results are presented showing target detection, subsurface characterizations, and imaging of insitu waste treatment processes, all previously unachievable with such tools as ground penetrating radar, magnetometry and seismic.

23108 (DOE/CH–9217) **Corrective Action Plan in response to the March 1992 Tiger Team Assessment of the Ames Laboratory.** Iowa State Univ. of Science and Technology, Ames, IA (United States). Inst. for Physical Research and Technology. 20 Nov 1992. 795p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-82. (IS–5094). Order Number DE93011566. Source: OSTI; NTIS; INIS; GPO Dep.

On March 5, 1992, a Department of Energy (DOE) Tiger Team completed an assessment of the Ames Laboratory, located in Ames, Iowa. The purpose of the assessment was to provide the Secretary of Energy with a report on the status and performance of

Environment, Safety and Health (ES&H) programs at Ames Laboratory. Detailed findings of the assessment are presented in the report, DOE/EH-0237, Tiger Team Assessment of the Ames Laboratory. This document, the Ames Laboratory Corrective Action Plan (ALCAP), presents corrective actions to overcome deficiencies cited in the Tiger Team Assessment. The Tiger Team identified 53 Environmental findings, from which the Team derived four key findings. In the Safety and Health (S&H) area, 126 concerns were identified, eight of which were designated Category 11 (there were no Category I concerns). Seven key concerns were derived from the 126 concerns. The Management Subteam developed 19 findings which have been summarized in four key findings. The eight S&H Category 11 concerns identified in the Tiger Team Assessment were given prompt management attention. Actions to address these deficiencies have been described in individual corrective action plans, which were submitted to DOE Headquarters on March 20, 1992. The ALCAP includes actions described in this early response, as well as a long term strategy and framework for correcting all remaining deficiencies. Accordingly, the ALCAP presents the organizational structure, management systems, and specific responses that are being developed to implement corrective actions and to resolve root causes identified in the Tiger Team Assessment. The Chicago Field Office (CH), IowaState University (ISU), the Institute for Physical Research and Technology (IPRT), and Ames Laboratory prepared the ALCAP with input from the DOE Headquarters, Office of Energy Research (ER).

23109 (DOE/EH–0258T-1) **General Employee Radiological Training and Radiological Worker Training: Program management manual.** USDOE Assistant Secretary for Environment, Safety, and Health, Washington, DC (United States). Oct 1992. 62p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93014777. Source: OSTI; NTIS; INIS; GPO Dep.

This manual defines and describes the DOE General Employee Radiological Training (GERT) and Radiological Worker I and II (RW I and II) Training programs. It includes material development requirements, standards and policies, and program administration. This manual applies to General Employee Radiological Training and Radiological Worker Training at all DOE contractor sites. The training materials of both GERT and RW I and II training reflect the requirements identified in the DOE Radiological Control Manual and DOE Order 5480.11. The training programs represent the minimum requirement for the standardized core materials. Each contractor shall implement the program in its entirety and may augment the standardized core materials to increase the general employee and radiological worker level of competency.

23110 (DOE/EH–0258T-2) **General Employee Radiological Training and Radiological Worker Training: Training aids.** USDOE Assistant Secretary for Environment, Safety, and Health, Washington, DC (United States). Oct 1992. 117p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93014778. Source: OSTI; NTIS; INIS; GPO Dep.

This volume contains copies of slides used with radiological workers in General Employee Radiological Training (GERT).

23111 (DOE/EH–0259T-1) **General Employee Radiological Training: Lesson plan.** USDOE Assistant Secretary for Environment, Safety, and Health, Washington, DC (United States). Oct 1992. 19p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93014779. Source: OSTI; NTIS; INIS; GPO Dep.

Upon completion of this class, the participant will be able to discuss his/her responsibilities for maintaining exposures to radiation and radioactive material As Low As Reasonably Achievable.

23112 (DOE/EH–0259T-2) **General Employee Radiological Training: Study guide.** USDOE Assistant Secretary for Environment, Safety, and Health, Washington, DC (United States). Oct 1992. 11p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93014780. Source: OSTI; NTIS; INIS; GPO Dep.

Upon completion of this class, the participant will be able to discuss his/her responsibilities for maintaining exposures to radiation and radioactive material As Low As Reasonably Achievable. The participant will be able to select the correct response from a group of responses which verifies his/her ability to: Identify natural background and man-made sources of radiation; state the whole body radiation exposure limit for non-radiological workers; state the potential biological effects from chronic radiation exposure; identify the ALARA concept and practices; state methods used to control radiological material; and state employee responsibilities for the ALARA Program.

23113 (DOE/EH–0260T-1) **Radiological Worker Training: Radiological Worker 1 lesson plans.** USDOE Assistant Secretary for Environment, Safety, and Health, Washington, DC (United States). Oct 1992. 103p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93014781. Source: OSTI; NTIS; INIS; GPO Dep.

Upon completion of this training course, the participant will have the knowledge to work safely in areas controlled for radiological purposes using proper radiological practices. Upon completion of this unit the participant will be able to identify the fundamentals of radiation, radioactive material and radioactive contamination. The participant will be able to select the correct response from a group of responses which verifies his/her ability to: Define ionizing radiation, radioactive material and radioactive contamination and identify the units used to measure radiation and radioactivity.

23114 (DOE/EH–0260T-2) **Radiological Worker Training: Radiological Worker 1 study guides.** USDOE Assistant Secretary for Environment, Safety, and Health, Washington, DC (United States). Oct 1992. 40p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93014782. Source: OSTI; NTIS; INIS; GPO Dep.

Upon completion of this training course, the participant will have the knowledge to work safely in areas controlled for radiological purposes using proper radiological practices.

23115 (DOE/EH–0261T-1) **Radiological Worker Training: Radiological Worker 2 lesson plans.** USDOE Assistant Secretary for Environment, Safety, and Health, Washington, DC (United States). Oct 1992. 142p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93014783. Source: OSTI; NTIS; INIS; GPO Dep.

Upon completion of this g course, the participant will have the knowledge to work safely in areas controlled for a radiological purposes using proper radiological practices. The participant will be able toidentify the fundamentals of radiation, radioactive material and radioactive contamination includes identify the three basic particles of an atom, define ionization, define ionizing radiation, radioactive material and radioactive contamination, distinguish between ionizing radiation and non-ionizing radiation, define radioactivity and radioactive half-life.

23116 (DOE/EH–0261T-2) **Radiological Worker Training: Radiological Worker 2 study guides.** USDOE Assistant Secretary for Environment, Safety, and Health, Washington, DC (United States). Oct 1992. 63p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93014784. Source: OSTI; NTIS; INIS; GPO Dep.

Upon completion of this training course, the participant will have the knowledge to work safely in areas controlled for radiological purposes using proper radiological practices. Radiological Worker H Training, for the worker whose job assignment involves entry into Radiological Buffer Areas and all types of Radiation Contamination and Airborne Radioactivity Areas. This course is designed to prepare the worker to work safely in and around radiological areas and present methods to use to ensure individual radiation exposure is maintained As Low As Reasonably Achievable.

23117 (DOE/EH–0262T-1) **Radiological control technician: Training program management manual.** USDOE Assistant Secretary for Environment, Safety, and Health, Washington, DC (United States). Oct 1992. 15p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93014785. Source: OSTI; NTIS; INIS; GPO Dep.

This manual defines and describes the DOE Radiological Control Technician Core Training Program qualification and training process, material development requirements, standards and policies, and administration. The manual applies to Radiological Control Technician Training Programs at all DOE contractor sites.

23118 (DOE/EH–0262T-2) **Radiological Control Technician: Standardized technician Qualification Standard.** USDOE Assistant Secretary for Environment, Safety, and Health, Washington, DC (United States). Oct 1992. 8p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93014786. Source: OSTI; NTIS; INIS; GPO Dep.

The Qualification Standard states and defines the knowledge and skill requirements necessary for successful completion of the Radiological Control Technician Training Program. The standard is divided into three phases: Phase I concerns RCT Academic training. There are 13 lessons associated with the core academics program and 19 lessons associated with the site academics program. The staff member should sign the appropriate blocks upon successful completion of the examination for that lesson or group of lessons. In addition, facility specific lesson plans may be added to meet the knowledge requirements in the Job Performance Measures (JPM) of the practical program. Phase II concerns RCT core/site practical (JPMs) training. There are thirteen generic tasks associated with the core practical program. Both the trainer/evaluator and student should sign the appropriate block upon successful completion of the JPM. In addition, facility specific tasks may be added or generic tasks deleted based on the results of the facility job evaluation. Phase III concerns the oral examination board successful completion of the oral examination board is documented by the signature of the chairperson of the board. Upon completion of all of the standardized technician qualification requirements, final qualification is verified by the student and the manager of the Radiological Control Department and acknowledged by signatures on the qualification standard. The completed Qualification Standard shall be maintained as an official training record.

23119 (DOE/EH–0262T-3) **Radiological Control Technician: Phase 1, Core academic training lesson plans.** USDOE Assistant Secretary for Environment, Safety, and Health, Washington, DC (United States). Oct 1992. 213p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93014787. Source: OSTI; NTIS; INIS; GPO Dep.

This volume provides instructors in the GERT program with lesson plans for Phase 1- Core Academic Training.

23120 (DOE/EH–0262T-4) **Radiological Control Technician: Phase 1, Core academic training study guides.** USDOE Assistant Secretary for Environment, Safety, and Health, Washington, DC (United States). Oct 1992. 241p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93014788. Source: OSTI; NTIS; INIS; GPO Dep.

This volume contains a study guide for training Radiological control Technicians. Covered here are core academic training in basic nuclear science and radiobiology.

23121 (DOE/EH–0262T-5) **Radiological Control Technician: Phase 1, Site academic training lesson plans.** USDOE Assistant Secretary for Environment, Safety, and Health, Washington, DC (United States). Oct 1992. 325p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93014789. Source: OSTI; NTIS; INIS; GPO Dep.

This volume provides lesson plans for training radiological control technicians. Covered here is basic radiological documentation, counting errors, dosimetry, environmental monitoring, and radiation instruments.

23122 (DOE/EH–0262T-6) **Radiological Control Technician: Phase 1, Site academic training study guides.** USDOE Assistant Secretary for Environment, Safety, and Health, Washington, DC (United States). Oct 1992. 213p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93014790. Source: OSTI; NTIS; INIS; GPO Dep.

This volume is a study guide for training Radiological Control Technicians. Provided herein are support materials for learning radiological documentation, communication systems, counting errors and statistics, dosimetry, contamination control, airborne sampling program methods, respiratory protection, radiological source control, environmental monitoring, access control and work area setup, radiological work coverage, shipment and receipt for radioactive material, radiological incidents and emergencies, personnel decontamination, first aid, radiation survey instrumentation, contamination monitoring, air sampling, and counting room equipment.

23123 (DOE/EH–0262T-7) **Radiological Control Technician: Phase 2, Core/site practical training.** USDOE Assistant Secretary for Environment, Safety, and Health, Washington, DC (United States). Oct 1992. 34p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93014791. Source: OSTI; NTIS; INIS; GPO Dep.

This volume provides a description of the guidelines, qualification in radiological instrumentation, qualification in radiological protection, and qualification in emergency preparedness for radiological control technicians.

23124 (DOE/EH–0262T-8) **Radiological Control Technician: Phase 2, Oral examination boards.** USDOE Assistant Secretary for Environment, Safety, and Health, Washington, DC (United States). Oct 1992. 10p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93014792. Source: OSTI; NTIS; INIS; GPO Dep.

This section outlines methods and guidelines for the implementation of Radiological Control Technician (RCT) oral examination boards as required by the Radiological Control Manual (RCM).

23125 (DOE/EH–0262T-9) **Radiological Control Technician: Phase 4, Facility practical training attachment.** USDOE Assistant Secretary for Environment, Safety, and Health, Washington, DC (United States). Oct 1992. 5p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93014793. Source: OSTI; NTIS; INIS; GPO Dep.

At DOE sites with more than one facility, and where RCT tasks at each facility may differ, site and facility tasks should be separated. The tasks that are common to all the facilities on the site should be included in Phase II training with the core tasks. Tasks unique to a facility should be added to the training program qualification standard, as an attachment, as Phase IV training. Not all the DOE sites will include Phase IV training in their programs. Phase IV training allows each site to qualify technicians to a select facility. Since the core training for the technicians is standardized, the transfer of technicians between facilities requires that only facility tasks be taught, provided the core qualification is current.

23126 (DOE/EH–0262T-10) **Radiological Control Technician: Training aids.** USDOE Assistant Secretary for Environment, Safety, and Health, Washington, DC (United States). Oct 1992. 90p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93014794. Source: OSTI; NTIS; INIS; GPO Dep.

This volume provides an outline of the lesson plan for General Employee Radiological Training (GERT).

23127 (DOE/OR–01-1115-D1) **Remedial Investigation work plan for Bear Creek Valley Operable Unit 4 (shallow groundwater in Bear Creek Valley) at the Oak Ridge Y-12 Plant, Oak Ridge, Tennessee.** Oak Ridge Y-12 Plant, TN (United States); Science Applications International Corp., Oak Ridge, TN (United States). Dec 1992. 330p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OS21400. (Y/ER–56-D1). Order Number DE93011835. Source: OSTI; NTIS; INIS; GPO Dep.

The enactment of the Resource Conservation and Recovery Act (RCRA) in 1976 and the Hazardous and Solid Waste Amendments (HSWA) to RCRA in 1984 created management requirements for hazardous waste fadities. The facilities within the Oak Ridge Reservation (ORR) were in the process of meeting the RCRA requirements when ORR was placed on the Comprehensive Environmental Response, Compensation, and Liability Act (CERCIA) National Priorities List (NPL) on November 21, 1989. Under RCRA, the actions typically follow the RCRA Facility Assessment (RIFA)/RCRA Facility Investigation (RFI)/Coffective Measures Study (CMS)/Corrective Measures Implementation process. Under CERCLA, the actions follow the Pre@ary Assessment/Site Investigation (PA/SI) Remedial Investigation Feasibility Study (RI/FS)/Remedial Design/Remedial Action process. The development of this document will incorporate requirements under both RCRA and CERCIA into an RI Work Plan for the lint phase of characterization of Bear Creek Valley (BCV) Operable Unit (OU) 4.

23128 (DOE/UMTRA–050506-Vol.5) **Remedial action plan and site design for stabilization of the inactive uranium mill tailings sites at Rifle, Colorado: Volume 5, Addenda D6–D8 to Appendix D: Final report.** USDOE Albuquerque Field Office, NM (United States). Uranium Mill Tailings Remedial Action Project Office. Feb 1990. 436p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC04-85AL20533. Order Number DE93012927. Source: OSTI; NTIS; INIS; GPO Dep.

This volume contains appendices D6 through D8 containing laboratory test data: from MK-F investigation, 1987, Old Rifle and New Rifle sites; on bentonite amended radon barrier material; and from MK-F investigation, 1987, riprap tests.

23129 (DPSP–55-454-5) **Savannah River Plant history plantwide activities, July 1954–December 1972.** Du Pont de Nemours (E.I.) and Co., Aiken, SC (United States). Savannah River Plant. [1972]. 280p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. (SR/H–535). Order Number DE93012789. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report recounts the yearly activities of the Savannah River Plant nonproduction agencies and is concerned mainly with Plant personnel and items of general interest. The "History of Plantwide Activities" is published as an accumulative document; at the end of each year a new writeup is added to the volume to bring it up to date. Writeups for 1955 and 1956 are based on the governmental fiscal year; those for 1957 and subsequent years are on a calendar year basis. The history of the period from prestartup through June 30, 1953, is presented in DPSP 53-368; the history from July 1953 through June 1954 is presented in DPSP 54-448.

23130 (DPSTSA–200-10-Suppl.5-Del.Ver.) **Safety analysis, 200 Area, Savannah River Plant H-Canyon operations: Supplement 5.** Beary, M.M. (Science Applications International Corp., San Diego, CA (United States)); Collier, C.D.; Fairobent, L.A.; Graham, R.F.; Mason, C.L.; McDuffee, W.T.; Owen, T.L.; Walker, D.H. Du Pont de Nemours (E.I.) and Co., Aiken, SC (United States). Savannah River Lab.; Science Applications International Corp., San Diego, CA (United States). Feb 1986. 403p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE93009881. Source: OSTI; NTIS; GPO Dep.

The H-Canyon facility is located in the 200 Separations Area and uses the HM process to separate uranium, neptunium, plutonium, and fission products. Irradiated uranium fuels containing ^{235}U at enrichments from 1.1% to 94% are processed and recovered, along with neptunium and plutonium isotopes. This Safety Analysis Report (SAR) documents an analysis of the H-Canyon operations and is an update to a section of a previous SAR. This SAR documents an analysis of the H-Canyon and is one of a series of documents for the Separations Area as specified in the Savannah River Implementation Plans. A substantial amount of the information supporting the Conclusions of this SAR is found in the Systems Analysis. Some H-Canyon equipment has been updated during the time between the Systems Analysis and this SAR and a complete description of this equipment is included in this report. The primary purpose of the analysis was to demonstrate that the H-Carbon can be operated without due risk to onsite or offsite populations and to the environment. In this report, risk is defined an the expected frequency of an accident, multiplied by the resulting radiological consequence in person-rem. The units of risk for radiological does are person-rem/year. Maximum individual exposure values have also been calculated and reported.

23131 (EGG-M–93031) **TRANSAX 92: A multi-jurisdictional exercise.** Green, D.W. (USDOE Idaho Field Office, Idaho Falls, ID (United States)). EG and G Idaho, Inc., Idaho Falls, ID (United States). [1993]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-76ID01570. (CONF-930402–3: 4. topical meeting on emergency preparedness and response, Long Island, NY (United States), 25-29 Apr 1993). Order Number DE93010806. Source: OSTI; NTIS; INIS; GPO Dep.

TRANSAX 92 was a national exercise sponsored by the Department of Energy that depicted a transportation accident involving a simulated transuranic waste shipment enroute to the Waste Isolation Pilot Plant in New Mexico. The participants in the exercise included federal, state, county, and tribal agencies. Personnel from the Shoshone-Bannock tribes served as the first responders. This created complex multi-jurisdictional issues to be resolved. As a result of the exercise, the capability to respond to transportation accidents involving hazardous materials in eastern Idaho was greatly enhanced.

23132 (FEMP–93010810) **Technology needs study: Fernald Environmental Management Project.** Westinghouse Environmental Management Co. of Ohio, Cincinnati, OH (United States). Fernald Environmental Management Project. Sep 1992. 260p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-86OR21600. Order Number DE93010810. Source: OSTI; NTIS; INIS; GPO Dep.

The Fernald Environmental Management Project (FEMP), formerly known as the Feed Materials Production Center and located approximately 20 miles northwest of Cincinnati, Ohio, was shut down in 1989 after producing uranium products since 1953. In October 1990, the site was transferred from DOE's Office of Defense Programs (DP) to the Office of Environmental Restoration and Waste Management (EM). Currently, EM is planning and conducting environmental remediation at the site. Uranium in metallic or chemical form is present in groundwater, soils, disposal pits, storage silos, and production facilities. Remediation involves using physical and chemical methods to accumulate uranium and its associated decay products and to prepare them for disposal. Observations and recommendations in this study were made for FEMP, EM-40, and EM-50 activities.

23133 (IS–5096) **Characterization, Monitoring and Sensor Technology Integrated Program.** Ames Lab., IA (United States); USDOE Office of Environmental Restoration and Waste Management, Washington, DC (United States). Office of Technology Development. [1993]. 77p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-82. Order Number DE93011563. Source: OSTI; NTIS; INIS; GPO Dep.

This booklet contains summary sheets that describe FY 1993 characterization, monitoring, and sensor technology (CMST) development projects. Currently, 32 projects are funded, 22 through the OTD Characterization, Monitoring, and Sensor Technology Integrated Program (CMST-IP), 8 through the OTD Program Research and Development Announcement (PRDA) activity managed by the Morgantown Energy Technology Center (METC), and 2 through Interagency Agreements (IAGs). This booklet is not inclusive of those CMST projects which are funded through Integrated Demonstrations (IDs) and other Integrated Programs (IPs). The projects are in six areas: Expedited Site Characterization; Contaminants in Soils and Groundwater; Geophysical and Hydrogeological Measurements; Mixed Wastes in Drums, Burial Grounds, and USTs; Remediation, D&D, and Waste Process Monitoring; and Performance Specifications and Program Support. A task description, technology needs, accomplishments and technology transfer information is given for each project.

23134 (KY/ER–15) **Evaluation of the proposed pilot groundwater pump and treat demonstration for the Paducah Gaseous Diffusion Plant: Environmental Restoration Program.** Bodenstein, G.W.; Bonczek, R.R.; Early, T.O.; Hale, T.B.; Huff, D.D.; Nickelson, M.D.; Rightmire, C.T. Paducah Gaseous Diffusion Plant, KY (United States). Nov 1992. 90p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400 ;AC05-76OU00001. (ORNL/M–2542). Order Number DE93012077. Source: OSTI; NTIS; INIS; GPO Dep.

This report contains the evaluation and recommendations of a Groundwater Corrective Actions Review Team. The primary goal is to evaluate the technical merit of and the need to implement a proposed groundwater pump-and-treat demonstration project for the Northwest contaminant plume at Paducah, Kentucky. A key distinction recognized by the review team is that the proposed project is intended to be a full-scale hydraulic containment of contaminants migrating from the sources of the plume, not plume remediation. The key questions incorporated into this plan are whether (1) dense, nonaqueous-phase liquids (DNAPLS) are present in the Regional Gravel Aquifer (RGA) at the source of the plume and (2) ^{99}Tc removal must be included as part of any groundwater treatment process. The first question cannot be answered until the

contaminant sources are better defined; the second question requires further risk assessment and/or a policy decision by DOE. Technical evaluation by the review team suggests that the recommended course of action be to modify the proposed work plan to include accurate identification of the sources of contaminants and vertical distribution of contaminants within the Northwest plume before a decision is made on the preferred source-control option. If DNAPLs are not present in the RGA, removal or containment of the sources is recommended. If DNAPLs are present, then hydraulic containment will be required. Finally, the review team recognizes that it is necessary to initiate a more comprehensive analysis of sitewide remediation needs to create links between action taken for the Northwest plume and action taken for other contamination sites at PGPD.

23135 (LA-UR–93-1366) **Radiological hazard classification of DOE facilities by DOE STD-1027-92: LANL nuclear facility list.** Elder, J.C. Los Alamos National Lab., NM (United States). [1993]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9304128–4: Department of Energy (DOE) radiation protection conference, Las Vegas, NV (United States), 13-15 Apr 1993). Order Number DE93012664. Source: OSTI; NTIS; INIS; GPO Dep.

Los Alamos facilities containing significant radiological hazards have been reclassified according to DOE-SID 1027-92, a recently issued guide for hazard classification. DOE-STD 1027-92 was provided in support of DOE Order 5480.23 to identify which facilities would be governed under DOE 5480.23 requirements; these would presumably be called nuclear facilities. This new classification has affected the original list of 18 LANL nuclear facilities by increasing it to 39. It has also lowered the classification of TA-55-4, the plutonium processing facility containing highest intrinsic hazard at LANL, from the highest classification to an intermediate classification. This presentation addresses the impact of these changes in the nuclear facility list in the areas of radiological health, safety analysis documentation, and risk management.

23136 **Safety harness.** Gunter, L.W. To Dept. of Energy. 8 Apr 1991. USA patent application 7-681,291. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE93008217. Source: OSTI; NTIS; GPO Dep.

A safety harness to be worn by a worker, especially a worker wearing a plastic suit thereunder for protection in a radioactive or chemically hostile environment. The safety harness comprises a torso surrounding portion with at least one horizontal strap for adjustably securing the harness about the torso, two vertical shoulder straps with rings just forward of the of the peak of the shoulders for attaching a life-line and a pair of adjustable leg supporting straps releasibly attachable to the torso surrounding portion. In the event of a fall, the weight of the worker, when his fall is broken and he is suspended from the rings with his body angled slightly back and chest up, will be borne by the portion of the leg straps behind his buttocks rather than between his legs. Furthermore, the supporting straps do not restrict the air supplied through hoses into his suit when so suspended.

23137 (PNL–8144) **State trends in ecological risk assessment and standard setting.** Siegel, M.R.; Fowler, K.M.; Bilyard, G.R. Pacific Northwest Lab., Richland, WA (United States). Feb 1993. 32p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93008948. Source: OSTI; NTIS; INIS; GPO Dep.

The purposes of this paper are (1) to identify key states' activities and plans related to setting cleanup standards using the ecological risk assessment process, and (2) to discuss the impacts these actions may have on the US Department of Energy's (DOE's) environmental restoration program. This report is prepared as part of a larger task, the purpose of which is to identify and assess state regulatory trends and legal developments that may impact DOE's environmental restoration program. Results of this task are intended to provide DOE with advance notice of potentially significant regulatory developments so as to enhance DOE's ability to influence these developments and to incorporate possible regulatory and policy changes into its planning process.

23138 (PNL–8570) **Evaluation of S-101 course Supervisors' Orientation to Occupational Safety in DOE" taught in Aiken, South Carolina, September 15–18, 1992.** Wright, T.S. Pacific Northwest Lab., Richland, WA (United States). Mar 1993. 19p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93010357. Source: OSTI; NTIS; GPO Dep.

This section summarizes trainee evaluations for the Safety Training Section course, "Supervisors' Orientation to Occupational Safety in DOE", (S-101) which was conducted September 15–18, 1992 at Westinghouse Savannah River, in Aiken, South Carolina. Sections 1.1 and 1.2 of this report summarize the quantitative course evaluations that trainees provided upon completion of the course. Section 1.3 summarizes the trainees written comments on the course and Section 1.4 provides examination results. Appendix A provides a transcript of the trainees' written comments and Appendix B presents the trainee evaluation form which students were asked to complete.

23139 (PNL–8572) **Evaluation of S-101 course "Supervisors' Orientation to Occupational Safety in DOE" taught in Amarillo, Texas, November 17–20, 1992.** Wright, T.S. Pacific Northwest Lab., Richland, WA (United States). Mar 1993. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93010358. Source: OSTI; NTIS; GPO Dep.

This summarizes trainee evaluations for the Safety Training Section course, "Supervisors' Orientation to Occupational Safety in DOE", (S-101) which was conducted November 17–20, 1992 at the Pantex Plant, in Amarillo, Texas. Sections 1.1 and 1.2 of this report summarize the quantitative course evaluations that trainees provided upon completion of the course. Section 1.3 provides written comments provided by the attendee, and Section 1.4 provides the examination results. Appendix A provides a transcript of the trainees' written comments and Appendix B provides the evaluation form.

23140 (PNL–8652) **Review of accident analysis calculations, 232-Z seismic scenario: Letter report.** Ballinger, M.Y. Pacific Northwest Lab., Richland, WA (United States). May 1993. 19p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93014184. Source: OSTI; NTIS; INIS; GPO Dep.

The 232-Z Building houses what was previously the incinerator facility, which is no longer in service. It is constructed out of concrete blocks and is approximately 37 ft wide by 57 ft long. The building has a single story over the process areas and two stories over the service areas at the north end of the building. The respective roofs are 15 ft and 19 ft above grade and consist of concrete over a metal decking, with insulation and a built-up asphalt gravel covering. This facility is assumed to collapse in the seismic event evaluated in the safety analyses, resulting in the release of a portion of the residual plutonium inventory remaining in the building. The seismic scenario for 232-Z assumes that the block concrete walls collapse, allowing the roof to fall, crushing the contaminated duct and gloveboxes within. This paper is a review of the scenario and methods used to calculate the source term from the seismic event as presented in the Plutonium Finishing Plant Final Safety Analysis Report (WHC 1991) also referred to as the PFP FSAR. Alternate methods of estimating the source term are presented. The calculation of source terms based on the mechanisms of release expected in worst-case scenario is recommended.

23141 (PNL-SA–20747) **The increasing importance of risk assessment and management in environmental decision-making.** Jaksch, J.A. Pacific Northwest Lab., Richland, WA (United States). Jun 1992. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-9206114–21: Annual meeting of the Air and Waste Management Association (AWMA), Kansas City, MO (United States), 21-26 Jun 1992). Order Number DE93009217. Source: OSTI; NTIS; GPO Dep.

Because environmental problems are growing and resources for dealing with them are shrinking, the environmental movement is witnessing an evolutionary shift toward greater emphasis on the

use of risk assessment and management tools in setting environmental standards, determining levels of cleanup and deciding environmental program funding priorities. This change has important ramifications for the Department of Energy (DOE) and its national laboratories in terms of the costs of weapons facilities cleanup, the types of cleanup technology that will be emphasized and the way the DOE programs will be run. Other Federal agencies responsible for cleanup operations [e.g., the Environmental Protection Agency (EPA) and the Department of Defense (DOD)] will be similarly affected. This paper defines risk management and risk assessment and explains why these concepts will be of growing importance in the 1990s. It also defines other relevant terms. The paper develops a rationale for why risk assessment and management will be of increasing importance in environmental decision-making in the 1990s and beyond.

23142 (PNL-SA–20922) **Recent advances in in situ vitrification.** Bonner, W.F.; Luey, Ja-Kael. Pacific Northwest Lab., Richland, WA (United States). May 1992. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-920527–10: 1992 incineration conference, Albuquerque, NM (United States), 11-14 May 1992). Order Number DE93007869. Source: OSTI; NTIS; GPO Dep.

In Situ Vitrification (ISV) is an innovative mobile remediation technology for soils and other underground contamination: Developed by the US Department of Energy's Pacific Northwest Laboratory (PNL), ISV has advanced during the past decade from a laboratory concept to a remediation technology commercially available for contaminated soils. ISV technology is currently being developed for remediation of DOE waste sites at Hanford, Oak Ridge National Laboratory (ORNL) Idaho National Laboratory (INEL), and other sites. The incentives for application of ISV can convert contaminated sites to a solid, highly durable block similar to naturally occurring obsidian. The ISV product has been shown capable of passing US Environmental Protection Agency (EPA) tests such as the Toxic Characteristic Leach Procedure (TCLP). Retrieval, handling and transport of untreated hazardous material would normally not be required after application of ISV. Therefore, costs, exposure to personnel, risk of releases to the environment, and generation of secondary wastes are greatly reduced compared with remove-and-treat technologies.

23143 (PNL-SA–20984) **Assessing the public regulatory acceptability of deploying new cleanup technologies: A case study of the integrated demonstration for Remediation of Volatile Organic Compounds at Arid Sites.** McCabe, G.H. (Battelle Seattle Research Center, WA (United States)); Stein, S.L. Pacific Northwest Lab., Richland, WA (United States). Aug 1992. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-920851–87: Spectrum '92: nuclear and hazardous waste management international topical meeting, Boise, ID (United States), 23-27 Aug 1992). Order Number DE93008261. Source: OSTI; NTIS; INIS; GPO Dep.

The US Department of Energy (DOE) is funding several integrated demonstrations (IDs) around the United States in an effort to improve the pace and effectiveness of cleaning up its sites. The objective of these IDs is to demonstrate an array of innovative cleanup technologies that address the specific needs at a site and to provide deployable technologies to all DOE sites with similar environmental problems. This approach eliminates the need to redemonstrate these technologies at multiple sites, thereby minimizing technology development cost and schedule requirements. However, for an ID to be truly successful, the technologies must be technically sound, acceptable to the various interested or concerned individuals and groups who feel they have a stake in the case (often referred to as stakeholders), and acceptable to the regulators responsible for approving the technologies' deployment. As a result, the ID for Remediation of Volatile Organic Compounds at Arid Sites (VOC-Arid ID) has instituted a process for assessing public and regulatory acceptability of the technologies that it is developing. As part of this process, an information system has been developed that describes the innovative technologies being supported under the VOC-Arid ID. It also compares innovative technologies with the baseline technologies currently in use by environmental restoration personnel.

23144 (PNL-SA–21476) **Overview of the Hanford Environmental Thermoluminescent Dosimetry Program.** Endres, A.W.; Peters, J.D. Pacific Northwest Lab., Richland, WA (United States). Jan 1993. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-930130–13: 26. Health Physics Society midyear topical meeting on environmental health physics, Coeur d'Alene, ID (United States), 24-28 Jan 1993). Order Number DE93007885. Source: OSTI; NTIS; INIS; GPO Dep.

The Hanford Environmental Thermoluminescent Dosimetry Program has been in operation for 30 years. The program's main goal is to report ambient penetrating radiation levels at specified locations on the Hanford Site and at nearby and distant communities. Dosimeter processing, dose calculation, and dose-reporting functions are provided by the Instrumentation and External Dosimetry section of the Pacific Northwest Laboratory's Health Physics Department. This presentation provides a brief historical overview of dosimeter designs, processing procedures, dose-calculation methodologies, calibration techniques, and quality control.

23145 (PNL-SA–21731) **In situ redox manipulation: Enhancement of contaminant destruction and immobilization.** Fruchter, J.S. Pacific Northwest Lab., Richland, WA (United States). Jan 1993. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-930160–8: 2. semi-annual Office of Technology Development (OTD) information meeting, Houston, TX (United States), 26-28 Jan 1993). Order Number DE93007877. Source: OSTI; NTIS; INIS; GPO Dep.

This report discusses a project to develop, test, and evaluate in situ methods for immobilizing inorganic contaminants (metals, inorganic ions, and radionuclides) and destroying nitrates organic contaminants, (primarily chlorinated hydrocarbons). This research work is being performed for the US Department of Energy through the In situ Remediation Integrated Program.

23146 (PNL-SA–22020) **An effective, non-threatening approach to evaluating safety program performance.** Wright, R.E. (Pacific Northwest Lab., Richland, WA (United States)); Walters, D.S.; Hillman, B.M. Pacific Northwest Lab., Richland, WA (United States). Apr 1993. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-9304127–1: Southeastern safety and health conference and exhibition, Atlanta, GA (United States), 26-28 Apr 1993). Order Number DE93013159. Source: OSTI; NTIS; GPO Dep.

The US Department of Energy has initiated a program to ensure a continual improvement in industrial safety at its facilities throughout the United States. To accomplish this, the Department of Energy is performing self-assessments of its safety programs. These assessments are effective at identifying program weaknesses without assigning fault to individuals. Line managers view this process as supportive because it has helped identify program deficiencies that are preventing them from accomplishing their desired safety goals. Three attributes of this assessment process account for its effectiveness. First, the assessment addresses the entire line management's safety program from policy to implementation in the work place. The assessment report describes how the safety program functions, where program deficiencies exist, and the effect of those deficiencies on safety in the field. Second, the assessment findings focus on program weaknesses that have been validated by observations of safety deficiencies found in the work place. Finally, the report is methodically written to ensure that findings are related only to program weaknesses and not personnel shortcomings. This effective, no-fault approach, has been demonstrated at Department of Energy facilities and could benefit safety programs in private industry.

23147 (UCRL-ID–111791) **Occupational consequences and source term calculations for a tritium release in the Device Assembly Facility (DAF).** Nguyen, D.H. Lawrence Livermore National Lab., CA (United States). Jan 1993. 35p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE93008753. Source: OSTI; NTIS; GPO Dep.

Tritium gas, normally in sealed containers, will be present in the Department of Energy (DOE)'s facilities conducting fusion energy research or weapon operations. A probability of tritium release, however small, exists in these facilities. Once released, tritium can back-diffuse against ventilation flow to contaminate other areas of

the facility. Tritium can also be released to the environment by exhaust blowers. The problem of back-diffusion of tritium released in a typical DOE facility was examined as a function of flow rates of the ventilation system. The "source term" (release to the environment) at the emergency ventilation flow was also calculated. The consequences to the occupational personnel in the release room, and in an adjacent corridor due to back-diffusion were determined. It was shown that for credible release scenarios, the consequences in the adjacent corridor from tritium back-diffusion were negligible. Higher doses in the release room can be avoided by well-planned emergency evacuation procedures. Although the "source term" was calculated, the on-site and off-site consequences were not determined in this study.

23148 (UCRL-JC–110582-Rev.1) **Development and evaluation of a HEPA filter for increased strength and resistance to elevated temperature: Revision 1.** Gilbert, H. (Gilbert (Humphrey), McLean, VA (United States)); Bergman, W.; Fretthold, J.K. Lawrence Livermore National Lab., CA (United States). Jan 1993. 20p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-920823–7-Rev.1: 22. Department of Energy (DOE)/Nuclear Regulatory Commission (NRC) nuclear air cleaning and treatment conference, Denver, CO (United States), 24-27 Aug 1992). Order Number DE93008023. Source: OSTI; NTIS; INIS; GPO Dep.

We have completed a preliminary study of an improved HEPA filter for increased strength and resistance to elevated temperature to improve the reliability of the standard deep pleated HEPA filter under accident conditions. The improvements to the HEPA filter consist of a silicone rubber sealant and a new HEPA medium reinforced with a glass cloth. Three prototype filters were built and evaluated for temperature and pressure resistance and resistance to rough handling. The temperature resistance test consisted of exposing the HEPA filter to 1,000 scan (1,700 m^3/hr) at 700°F (371°C) for five minutes.The pressure resistance test consisted of exposing the HEPA filter to a differential pressure of 10 in. w.g. (2.5 kPa) using a water saturated air flow at 95°F (35°C). For the rough handling test, we used a vibrating machine designated the Q110. DOP filter efficiency tests were performed before and after each of the environmental tests. In addition to following the standard practice of using a separate new filter for each environmental test, we also subjected the same filter to the elevated temperature test followed by the pressure resistance test. The efficiency test results show that the improved HEPA filter is significantly better than the standard HEPA filter. Further studies are recommended to evaluate the improved HEPA filter and to assess its performance under more severe accident conditions.

23149 (WSRC-MS–93-146) **Report on Subgroup on Data Banks for Risk Assessment.** Durant, W.S. Westinghouse Savannah River Co., Aiken, SC (United States). [1993]. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. (CONF-9306143–1: Energy Facility Contractors Group safety analysis meeting, Denver, CO (United States), 16-18 Jun 1993). Order Number DE93012150. Source: OSTI; NTIS; GPO Dep.

As a result of discussions between the Westinghouse Management and Operations (M&O) Nuclear Facility Safety Committee and Stephen M. Blush, Director of Nuclear Safety, US Department of Energy, the Safety Analysis Working Group Steering Committee agreed to sponsor the formation of a subgroup on data banks for risk assessment. The newly created Safety Analysis Working Group Subgroup on Data Banks for Risk Assessment met February 2–3, 1993 in Augusta Georgia. This report highlights the topics of this meeting.

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Refer also to citation(s) 23651, 25409

23150 (JAERI-M–93-053) **CASDAC system: Monitoring Unit user's guide.** Yamamoto, Yoichi (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Tokai Research Establishment); Koyama, Kinji. Japan Atomic Energy Research Inst., Tokyo (Japan). Mar 1993. 23p. Order Number DE93797605. Source: OSTI; NTIS; INIS.

The CASDAC (Containment And Surveillance Data Authenticated Communication) system has been developed by JAERI for nuclear safeguards and physical protection of nuclear material. This system is a remote monitoring system for continual verification of security and safeguards status of nuclear material. The CASDAC system consists of two subsystems, one of them is a Grand Command Center (GCC) subsystem and the other is a facility subsystem. This report describes the outline and usage of the Monitoring Unit (MU), which monitors continuously C/S sensor status in a facility subsystem. This work has been carried out in the framework of Japan Support Programme for Agency Safeguards (JASPAS) as a project, JA-1. (author).

23151 (JAERI-M–93-054) **CASDAC system: Data Terminal Equipment user's guide.** Yamamoto, Yoichi (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Tokai Research Establishment); Koyama, Kinji. Japan Atomic Energy Research Inst., Tokyo (Japan). Mar 1993. 25p. Order Number DE93797606. Source: OSTI; NTIS; INIS.

The CASDAC (Containment And Surveillance Data Authenticated Communication) system has been developed by JAERI for nuclear safeguards and physical protection of nuclear material. This system is a remote monitoring system for continual verification of security and safeguards status of nuclear material. The CASDAC system consists of two subsystems, one of them is a Grand Command Center (GCC) subsystem and the other is a facility subsystem. This report describes the outline and usage of the Data Terminal Equipment (DTE), which makes available of message data communication between the GCC and a facility subsystem. This work has been carried out in the framework of Japan Support Programme for Agency Safeguards (JASPAS) as a project, JA-1. (author).

23152 (JAERI-M–93-055) **CASDAC system: On-Site Multiplexer user's guide.** Yamamoto, Yoichi (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Tokai Research Establishment); Koyama, Kinji. Japan Atomic Energy Research Inst., Tokyo (Japan). Mar 1993. 49p. Order Number DE93797607. Source: OSTI; NTIS; INIS.

The CASDAC (Containment and Surveillance Data Authenticated Communication) system has been developed by JAERI for nuclear safeguards and physical protection of nuclear material. This system is a remote monitoring system for continual verification of security and safeguards status of nuclear material. The CASDAC system consists of two subsystems, one of them is a Grand Command Center (GCC) subsystem and the other is a facility subsystem. This report describes the outline and usage of the On-Site Multiplexer (OSM), which controls all other equipments in a facility subsystem and communicates with the GCC. This work has been carried out in the framework of Japan Support Programme for Agency Safeguards (JASPAS) as a project, JA-1. (author).

23153 (K/CSD/INF–87/13-Rev.1) **Nuclear Materials Management and Safeguards System (NMMSS): Revision 1.** Jacobsen, S.E.; Matthews, W.B. III; McKamy, E.D.; Pedigo, R.B. Oak Ridge K-25 Site, TN (United States). [1991]. 4p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC05-84OR21400. (CONF-910774–106-Rev.1: 32. Institute of Nuclear Materials Management (INMM) annual meeting, New Orleans, LA (United States), 28-31 Jul 1991). Order Number DE93009336. Source: OSTI; NTIS; GPO Dep.

This paper describes the Nuclear Materials Management and Safeguards System (NMMSS) which is sponsored by the Department of Energy and the Nuclear Regulatory Commission. The system serves national security and program management interests, and international interests in the programs for the peaceful application of nuclear energy and non-proliferation of nuclear weapons. Within the scope of the NMMSS are found all nuclear materials applied and controlled under United States law and related international agreements, including U.S. nuclear materials production programs and US private nuclear industrial activities. In addition, its national and international scope enables it to provide services to other organizations such as the Arms Control and Disarmament Agency, the Department of State, and the US Congress.

23154 (K/ITP–486) **Field measurements to support IAEA procedures development for fuel assembly and fuel rod active length verification.** Belew, W.L.; Cooley, J.N.; Whitaker, J.M. Oak Ridge K-25 Site, TN (United States). 17 Jul 1992. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OT21400. (CONF-9207102–79: Institute of Nuclear Materials Management (INMM) annual meeting, Orlando, FL (United States), 19-22 Jul 1992). Order Number DE93012415. Source: OSTI; NTIS; INIS; GPO Dep.

The activities performed in verification of reactor fuel rods and assemblies by International Atomic Energy Agency (IAEA) safeguards inspectors include measurements of the length of the enriched uranium sections in fuel assemblies and fuel rods. These measurements are normally made with the IAEA hand-held gamma monitor (HM-4) on fuel elements containing only enriched uranium. Many fuel rods currently in use contain natural uranium end sections and several different ^{235}U enrichment zones. To support development of standard procedures for IAEA nondestructive assay (NDA) measurements, a field measurement campaign was carried out to evaluate the FM-4 measurements and to investigate the feasibility of extending the HM-4 measurements to fuel rods and assemblies containing both natural and enriched uranium sections. The results show that the enriched fuel length can be measured to within $\pm$ 1 to 2 cm in the presence of natural uranium sections and to within $\pm$ 0.5 = when only enriched uranium is present. Based on the results from these measurements, a standard procedure, "Measurement of Active Fuel Length in Fuel Assemblies and Fuel Rods Using the HM-4," has been drafted for review by the IAEA.

23155 (SAND–92-2781C) **Portable Reconfigurable Line Sensor (PRLS).** Buckle, T.H.; Christiansen, M.L. Sandia National Labs., Albuquerque, NM (United States). [1992]. 8p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-9305110–2: Expo 93, Oak Ridge, TN (United States), May 1993). Order Number DE93013756. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The Portable Reconfigurable Line Sensor (PRLS) is a bistatic, pulsed-doppler radar security sensor developed at Sandia National Laboratories for the US Air Force. The PRLS is rapidly and easily deployed byunskilled personnel and can detect intruders ranging from a slow creeping person to a high speed vehicle. The sensor has a sharply defined detection zone and will not falsely alarm on nearby traffic. Unlike other microwave sensor systems, the PRLS requires no alignment or calibration. Alignment is not required because the PRLS is equipped with an omnidirectional antenna. The PRLS's unique ellipsoidal detection zone eliminates the need for an offset distance to achieve total detection coverage. The sensors themselves are inside their own detection zone and are therefore self-protecting. Other unique features of the PRLS areits limited terrain-following capability and its ability to minimize the effects of rippling water and blowing grass. Its portability, battery operation, ease of setup and RF aldrin reporting capability make itan excellent choice for perimeter, portal, and gap-filler applications in the important new field of rapidly-deployable sensor systems. Sandia is currently transferring the PRLS technology to a private firm, Racon, Inc. (Seattle, WA), through an Air Force/Racon Cooperative Research and Development Agreement (CRADA). Through the CRADA, Sandia engineers are working with Racon engineers to develop a commercial version of the PRLS. Racon receives the benefit of Sandia security systems and radar development expertise, while Sandia engineers are gaining valuable exposure to important commercial manufacturing constraints and requirements. The Racon product will be available in 1993.

23156 (UCRL-ID–106470) **Evaluating safeguards effectiveness against protracted theft of special nuclear material by insiders.** Al-Ayat, R.A.; Patenaude, C.J.; Sicherman, A. Lawrence Livermore National Lab., CA (United States). Feb 1992. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE93011878. Source: OSTI; NTIS; GPO Dep.

The new draft DOE Material Control and Accountability Order 5633.3 requires that facilities handling special nuclear material (SNM) evaluate their effectiveness against protracted theft of SNM. Protracted theft means repeated thefts of small quantities of material to accumulate a goal quantity. To evaluate the safeguards effectiveness against protracted thefts, one must addresses several issues: (1) defining relevant time frames for various threat scenarios and delayed detection safeguards; (2) identifying which safeguards come into play more than once because of repeated adversary actions or because of periodic occurrence during the theft time frame (e.g., daily administrative check on presence of material); (3) considering whether the second and subsequent applications of safeguards are different in effectiveness from the first; (4) synthesizing how physical security, material control, and material accountability safeguards combine to provide protection against protracted theft scenarios. In this paper we discuss these issues and describe how we are augmenting the Analytic System and Software for Evaluating Safeguards and Security (ASSESS) to provide the user with a tool for evaluating effectiveness against protracted theft. Currently, the Insider module of ASSESS focuses on evaluating the "timely" detection of abrupt theft attempts by various types of single nonviolent insiders. In this paper we describe the approach we're implementing to augment ASSESS to handle various cases of protracted theft attempts.

23157 (UCRL-JC–110102) **Multi-state modeling in ASSESS.** Fortney, D.S. (Lawrence Livermore National Lab., CA (United States)); Patenaude, C.J.; Snell, M.K.; Key, B. Lawrence Livermore National Lab., CA (United States). 6 Jul 1992. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48 ;AC04-76DP00789. (CONF-9207102–80: Institute of Nuclear Materials Management (INMM) annual meeting, Orlando, FL (United States), 19-22 Jul 1992). Order Number DE93012485. Source: OSTI; NTIS; GPO Dep.

The Analytic System and Software for Evaluating Safeguards and Security (ASSESS) is an integrated safeguards evaluation tool focusing on theft and diversion of special nuclear material (SNM) by insiders, outsiders, and collusion between insiders and outsiders. ASSESS features a common Facility Description module that allows for defining a facility's safeguards and security system simultaneously for both insiderand outsider threats. This Facility Description module supports defining safeguards during two states. The two states could represent "day" and "night," or "normal" and "emergency," or simply "open" and "closed." A problem arises due to differences in the modi operandi of (and hence, evaluation approaches for) insider and outsider threats. This can lead to situations where it is impossible to simultaneously define states correctly to meet the needs of both the Insider and Outsider evaluation modules. We have developed and are currently implementing an approach to address this problem. This approach has required-programming in four ASSESS modules. In this paper, we discuss the ASSESS state problem and give an overview of the solution, including the implementation in the Facility and Insider modules. A second paper discussing details of the implementation in the Outsider module is also being presented in this session.

23158 (UCRL-JC–110107) **A simulation model for uranium recovery processes.** Chang, L. (Lawrence Livermore National Lab., CA (United States)); Edmunds, T.A.; Knox, T.T.; Johns, R.E. Lawrence Livermore National Lab., CA (United States). 17 Jul 1992. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9207102–73: Institute of Nuclear Materials Management (INMM) annual meeting, Orlando, FL (United States), 19-22 Jul 1992). Order Number DE93009522. Source: OSTI; NTIS; GPO Dep.

The Portsmouth Gaseous Diffusion Plant will suspend production of highly enriched uranium (HEU). Suspension plans require that equipment containing significant amounts of HEU deposits be disassembled, decontaminated, and placed on standby. The procedural, personnel and hardware limitations of the uranium recovery facility may delay this effort, in part because this same facility must maintain concurrent support for the decontamination of equipment used for low enrichment operations. To facilitate planning and operations for this clean-up effort, a model that simulates facility operation and obtains estimates of the time to clean up all HEU-contaminated components has been developed. The model simulates the effects of random events, such as machine breakdowns, and uncertain parameters, such as contamination levels,

on the facility process flow. The model has been used to evaluate alternative process configurations and operating procedures in the uranium recovery facility.

23159 (WHC-SA–1870) **The Hanford Site multiple function badge demonstration project.** Nelson, R.A. Westinghouse Hanford Co., Richland, WA (United States). Mar 1993. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. (CONF-9304111–2: Magnetic stripe card technology seminar: CardTech/Secur/Tech, Arlington, VA (United States), 19 Apr 1993). Order Number DE93011353. Source: OSTI; NTIS; GPO Dep.

The US Department of Energy Hanford Site is an original defense production site dating from World War II. The US Department of Energy assigned a new waste management mission for the Hanford Site. This mission requires fewer manned security posts and more areas restricted because of safety and environmental concerns. Entry into these areas requires specific safety and environmental qualifications, which could be controlled by automated access control systems. Automated entry reduces costs of managing the Site but requires health physics, safety, employee training, security databases integration, and a network system. Another approach, avoiding integration, is individuals carrying this information on their person as a picture identity badge and access control token. The health physics, safety, employee training, and security regulations that define access requirements may be best served using a smart card as the access control token. This paper discusses the need for information distribution and automated access control, potential approaches for solving the need, and smart card work at the Hanford Site.

0560 Legislation and Regulations

Refer also to citation(s) 22948, 22961, 23473, 23474, 23475, 23476, 23477, 23478, 23479

23160 (INIS-XN–436) **31 March 1992 - Royal Order amending Section 133(1) of the General Regulation on safety at Work concerning protection of workers against the hazards of ionizing radiation.** Belgium. 24 Apr 1992. [2p.] (In French). Order Number DE93626595. Source: OSTI; NTIS (US Sales Only); INIS.

Published in Moniteur belge.

A Royal Order of 31 March 1992 amends certain provisions of the Regulations on safety at work with respect to protection of workers against the hazards of ionizing radiation, amended in 1990. The purpose of the amendment is to avoid that certain international and national civil servants be hindered in their control duties. The following inspectors are concerned: the International Atomic Energy Agency inspectors; the persons designated as responsible for surveillance under the Euratom Treaty and the Act of 1955 on State security in the nuclear field; the inspectors designated by the Act of 1972 on inspections at work. (NEA).

23161 (INIS-XN–437) **17 June 1992 - Royal Order amending the Royal Order of 28 February 1963 laying down the General Regulations for protection of the population and workers against the hazards of ionizing radiation.** Belgium. 23 Jun 1992. [3p.] (In French). Order Number DE93626585. Source: OSTI; NTIS (US Sales Only); INIS.

Published in Moniteur belge.

This Royal Order replaces certain provisions of the General Regulations for protection of the population and workers against the hazards of ionizing radiations. The new provisions concern the monitoring of radioactivity in the national territory and population dose, as well as monitoring of the population as a whole. The purpose of this amendment is to conform without delay to the Opinion of the Commission of the European Communities; the amendment concerns mainly the monitoring of doses received by the population and the technical conditions for such monitoring. (NEA).

23162 (INIS-XN–439) **SOR/92-150 - 27 February 1992 - Transport Packaging of Radioactive Materials Regulations, Amendment.** Canada. 11 Mar 1992. [2p.] Order Number DE93626590. Source: OSTI; NTIS (US Sales Only); INIS.

Published in Canada Gazette Part II Vol. 126 No 6.

The amendments to the Transport Packaging of Radioactive Materials Regulations now simplify the registration procedure for obtaining certificates for package designs. (NEA).

23163 (INIS-XN–440) **SOR/92-149 - 27 February 1992 - AECB Cost Recovery Fees Regulations, amendment.** Canada. 11 Mar 1992. [3p.] Order Number DE93626591. Source: OSTI; NTIS (US Sales Only); INIS.

Published in Canada Gazette Part III Vol. 126 No 6.

The AECB began in 1990 to charge fees for the registration of each user of a certified package for the transport radioactive materials. This amendment was made to simplify the registration procedure. (NEA).

23164 (INIS-XN–441) **Order of 23 May 1991 on electron accelerators using energies of from 1 MeV to 50 MeV for the treatment of patients.** Denmark. 31 May 1991. [6p.] (In Danish). Order Number DE93626586. Source: OSTI; NTIS (US Sales Only); INIS.

Published in Lovtidende 1991 Part A, No 70.

This order made by the National Board of Health also implements Directive No. 84/466 Euratom of 3 September 1984 laying down basic measures for radiation protection of persons undergoing medical treatment. The Order prescribes measures to protect patients treated by electron accelerators using energies from 1 MeV to 50 MeV. It contains provisions on approval procedures for electron accelerators, their design, the shielding and safety systems for premises where they are housed, their supervision and quality control and finally, their inspection by the Board of Health. (NEA).

23165 (INIS-XN–442) **Order of 24 July 1992 on the licensing of liquid radioactive effluent releases from the large nuclear installation called Atalante at the nuclear research centre in the Rhone valley on the Marcoule nuclear site.** France. 22 Aug 1992. [1p.] (In French). Order Number DE93626587. Source: OSTI; NTIS (US Sales Only); INIS.

Published in the Journal Official de la Republique francaise.

This Order fixes the annual authorized limits and procedures for the transfer from Atalante to the Cogema establishment also at Marcoule of the low-level liquid effluents for treatment. It also specifies the measures for their control and surveillance. (NEA).

23166 (INIS-XN–443) **Order of 24 July 1992 on the licensing of gaseous radioactive effluent releases from the large nuclear installations called Atalante at the nuclear research centre in the Rhone valley on the Marcoule nuclear site.** France. 29 Aug 1992. [1p.] (In French). Order Number DE93626588. Source: OSTI; NTIS (US Sales Only); INIS.

Published in the Journal Officiel de la Republique francaise.

This Order fixes the annual authorized limits and procedures for radioactive effluent releases from Atalante. It also specifies the measures for their control and surveillance. (NEA).

23167 (INIS-XN–444) **Radioactive Material (Road Transport) Act 1991.** United Kingdom. 27 Jun 1991. [7p.] Order Number DE93626592. Source: OSTI; NTIS (US Sales Only); INIS.

This Act came into force on 27 August 1991. It replaces earlier legislation dating from 1948 and enables the United Kingdom to give effect to the International Atomic Energy Agency's (IAEA) latest recommended Regulations for the Safe Transport of Radioactive Material. The new Act clarifies and extends the power of the Secretary of State to make regulations regarding, among other things, the design, labelling, handling, transport and delivery of packages containing radioactive material and the placarding of vehicles transporting such packages. The Act gives the Secretary of State the power to appoint inspectors to assist him in enforcing the regulations. (NEA).

23168 (INIS-XN–445) **Health Ministry - Regulatory Decree No 3/92 of 6 March.** Portugal. 6 Mar 1992. [2p.] (In Portuguese). Order Number DE93626589. Source: OSTI; NTIS (US Sales Only); INIS.

Published in Diario da Republica - I Serie B No 55.

The 1990 Decree, adopted in implementation of the Euratom Directives laying down basic radiation protection standards, establishes the basic principles in the field of radiation protection applicable to occupationally exposed persons, individuals and the

population as a whole. This Decree amends the 1990 Decree to further clarify certain of its provisions. Consequently, a new paragraph has been added to Section 36 of the 1990 Decree on exemptions which specifies in particular the cases which are not exempted from prior licensing. (NEA).

07 ISOTOPE AND RADIATION SOURCE TECHNOLOGY

0701 Physical Isotope Separation

Refer also to citation(s) 22871, 22872, 24977

23169 (DOE/ER/12120–1) **The plasma centrifuge (A compact, low cost, stable isotope separator): Progress report, [September 15, 1991–September 14, 1992].** Science Research Lab., Inc., Somerville, MA (United States). [1992]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-91ER12120. Order Number DE93015933. Source: OSTI; NTIS; INIS; GPO Dep.

The Mark-I centrifuge assembly includes an electromagnet, a vacuum chamber, and a Nd:YAG laser. Three tasks have been completed: design, component order, and laboratory test cell preparation. Two task are being pursued: design plasma diagnostics/collection hardware/mass analyzers, and assemble Mark I centrifuge. Experiments with rotation of C plasmas will be conducted. 4 figs.

23170 (INDC(NDS)–213/GM3, pp. 48) **Appendix 2.** Adair, H.L. (Oak Ridge National Lab., TN (United States)). International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Oct 1988. (CONF-8809159–: 14. world conference of the International Nuclear Target Development Society (INTDS): heavy-ion targets and related phenomena, Darmstadt (Germany), 5-9 Sep 1988). In *The influence of target and sample properties on nuclear data measurements: Summary report of the IAEA advisory group meeting in co-operation with the International Nuclear Target Development Society (INTDS), held in Darmstadt, Germany, 5-9 September 1988.* [74p.] Order Number DE93626092. Source: OSTI; NTIS (US Sales Only); INIS.

The Oak Ridge National Laboratory Isotope Distribution Program (IOP) provides isotope research materials for research, development, and production applications. Most of the isotopes of elements in the periodic chart are available on an international basis, from this program. The general list of materials and services are detailed below: radioisotopes, enriched stable isotopes, special nuclear materials, and unique isotope products and services. In addition to the above, routine fabrication processes are available to prepare both stable and radioisotope samples to meet the most stringent requirements. Specific details on isotopic materials and services available through the IOP can be obtained by writing to the following address: Oak Ridge National Laboratory, Isotope Distribution Program, P.O. Box 2008, Building 3037, Oak Ridge, Tennessee 37831, Phone 615-574-6984. (author). Abstract only.

23171 (INDC(NDS)–213/GM3, pp. 49) **Supply of samples and targets by CBNM, Geel, Belgium.** Pauwels, J. International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Oct 1988. (CONF-8809159–: 14. world conference of the International Nuclear Target Development Society (INTDS): heavy-ion targets and related phenomena, Darmstadt (Germany), 5-9 Sep 1988). In *The influence of target and sample properties on nuclear data measurements: Summary report of the IAEA advisory group meeting in co-operation with the International Nuclear Target Development Society (INTDS), held in Darmstadt, Germany, 5-9 September 1988.* [74p.] Order Number DE93626092. Source: OSTI; NTIS (US Sales Only); INIS.

Samples and targets for nuclear measurements have been supplied by CBNM for more than 25 years. They are generally supplied upon request according to specifications to be agreed upon between the customer and the laboratory. They include: Thin layers of several actinide and other materials of nuclear interest prepared by vacuum deposition, electrospraying, spraypainting, etc. Most targets can be supplied on very thin substrate foils, especially on 20 to 40 $\mu g/cm^2$ polyimide foils. Under optimal conditions the number of nuclide atoms can be determined with accuracies below 1%; Bulk samples of metals or oxides prepared from fine materials and/or enriched isotopes; Alloy samples in different forms and shapes prepared by quantitative alloying using e.g. high-frequency levitation melting. These include dosimetry alloys (e.g. AlCo, AlU, VNp,...), metallic spikes for isotope dilution mass spectrometry (e.g. U-Pu alloys), etc.; Reference materials for the non-destructive analysis of the isotope composition of uranium or for reactor neutron dosimetry ($^{238}UO_2$, $^{237}NpO_2$, Ni, Cu, Fe, Al, Nb, AlCo). Finally, more than 1000, mainly actinide deposits are available from stock. A regularly updated computer list of these can be obtained upon request. (author). Abstract only.

23172 (INDC(NDS)–213/GM3, pp. 73-74) **Target development for medical radioisotope production at a cyclotron.** Qaim, S.M. (Forschungszentrum Juelich GmbH (Germany). Inst. fuer Chemie 1 - Nuklearchemie). International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Oct 1988. (CONF-8809159–: 14. world conference of the International Nuclear Target Development Society (INTDS): heavy-ion targets and related phenomena, Darmstadt (Germany), 5-9 Sep 1988). In *The influence of target and sample properties on nuclear data measurements: Summary report of the IAEA advisory group meeting in co-operation with the International Nuclear Target Development Society (INTDS), held in Darmstadt, Germany, 5-9 September 1988.* [74p.] Order Number DE93626092. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. ISOTOPE PRODUCTION/targets; CYCLOTRONS; TARGETS; RADIOISOTOPES

23173 (INDC(NDS)–213/GM3, pp. 50) **The supply of stable and active isotopes and targets from the Harwell Laboratory.** Wiltshire, R.A.P. International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Oct 1988. (CONF-8809159–: 14. world conference of the International Nuclear Target Development Society (INTDS): heavy-ion targets and related phenomena, Darmstadt (Germany), 5-9 Sep 1988). In *The influence of target and sample properties on nuclear data measurements: Summary report of the IAEA advisory group meeting in co-operation with the International Nuclear Target Development Society (INTDS), held in Darmstadt, Germany, 5-9 September 1988.* [74p.] Order Number DE93626092. Source: OSTI; NTIS (US Sales Only); INIS.

A wide range of active and stable isotopes from ^{6}Li through to ^{252}Cf are currently available from the Harwell laboratory. Nuclides can be supplied as solids, liquids and targets manufactured to customers specifications. ^{57}Fe and ^{119}Sn for use as Moessbauer absorbers are held in stock. An extensive range of carbon foils for use as beam stripper foils and target backings can be manufactured. Radioactive sources of single or multiple nuclides can be prepared and calibrated to high accuracy. ^{252}Cf fabricated for use as fission fragment sources are held in stock. Tracer solutions of ^{227}Ac through to ^{252}Cf for environmental and dio-equilibrium studies are available from stock. Enquiries are invited for variable energy cyclotron (VEC) or reactor produced nuclides. A UK export license is required for some isotopes and information on the end use and user may be required. Enquiries should be addressed to: Actinide Chemistry and Analysis Group, Chemistry Division, Harwell Laboratory, Oxfordshire OX11 0RA, England, Telex 83135, Telephone (0235) 24141 ext. 4212. (author). Abstract only.

0702 Radiation Sources

Refer also to citation(s) 24011, 24860, 25177

23174 (INIS-JP–007, pp. 309-317) **Achievements and perspectives for radiation processing.** Charlesby, A. (RMC, Swindon (UK)). Japan Atomic Energy Research Inst., Tokyo (Japan). 1992. 817p. (CONF-911154–: International conference on evolution in beam applications, Takasaki (Japan), 5-8 Nov 1991). In *Proceedings of the international conference on evolution in beam applications.* Order Number DE93703820. Source: OSTI; NTIS; INIS.

In the last few decades the major practical applications of large radiation sources have been in the irradiation of macromolecular

systems. These have risen rapidly to annual outputs of billions of dollars and continue to show steady growth. In other directions such as polymerization and grafting, radiation has been less successful, primarily because in these subjects radiation serves as only one step in a sequence of chemical reactions, and often these can be achieved by more conventional and familiar methods. We envisage future progress along several distinct lines. 1. Reduction in the cost of radiation. 2. The application of radiation technology in areas where valuable modifications are involved and where advantage can be taken of the remarkable control offered by electron beams. 3. Areas where the chemical alternatives do not exist or are difficult to apply. 4. A very different line of approach is to use radiation with its far more complete control and reproducibility to investigate many processes even if in the production stage itself a different technique is later utilized. Present examples are chemical kinetics as with ESR, pulse radiolysis, pulsed NMR, behavior of trapped charges, crystal structure, local modifications, reinforcement and orientation etc. (J.P.N.).

23175 (INIS-JP–007, pp. 410-416) **Environmental and conservation considerations for electron curing.** Nablo, S.V. (Energy Sciences, Inc., Wilmington, MA (United States)); Fletcher, P.M. Japan Atomic Energy Research Inst., Tokyo (Japan). 1992. 817p. (CONF-911154–: International conference on evolution in beam applications, Takasaki (Japan), 5-8 Nov 1991). In *Proceedings of the international conference on evolution in beam applications.* Order Number DE93703820. Source: OSTI; NTIS; INIS.

This paper reviews the more important features of electron curing pertaining to environmental protection and conservation. The high electrical conversion efficiencies of these devices measured at output power levels to 200 kilowatts are reviewed with attention to energy transport to the product. The comparative energetics of free radical initiated addition chemistry with that of the more conventional condensation polymerized systems are presented. Some details of recent studies of the repulpability and de-inkability of electron cured products are presented with mill scale trials showing successful recycling with up to 75 % EB processed material in the waste. The ability of energetic electrons to effectively replace toxic chemicals such as H_2O_2 and ethylene oxide in product sterilization will be presented with a discussion of the regulatory aspects of this process for medical device applications. (author).

23176 (INIS-JP–007, pp. 505-510) **Some chemical properties of irradiated empty fruit bunch and palm press fiber of oil palm byproducts.** Matsuhashi, Shinpei (Japan Atomic Energy Research Inst., Takasaki, Gunma (Japan). Takasaki Radiation Chemistry Research Establishment); Kume, Tamikazu; Othman, Z.BT.; Awang, M.R. Japan Atomic Energy Research Inst., Tokyo (Japan). 1992. 817p. (CONF-911154–: International conference on evolution in beam applications, Takasaki (Japan), 5-8 Nov 1991). In *Proceedings of the international conference on evolution in beam applications.* Order Number DE93703820. Source: OSTI; NTIS; INIS.

Effect of irradiation and alkali treatment for digestibility of oil palm by-products by commercial enzymes was investigated to obtain the informations about formation of carbohydrate polymers or sugar components for producing animal feed from cellulosic by-products. According to the colorimetric analysis, produced reducing sugar from holocellulose of Empty Fruit Bunch (EFB) and Palm Press Fiber (PPF) by Cellulase ONOZUKA 3S were about ten times higher than those from raw samples. The results show that the digestibility of EFB and PPF increased significantly by delignification. The differences of digestibility between irradiated and unirradiated samples were shown clearly by the combination of enzymatic degradation and the HPLC analysis. By irradiation, digestibility of EFB was significantly increased. Higher dose is more effective for the digestion of EFB by enzyme. Alkali treatment is also quite effective to enzymatic degradation. The difference of neutral sugar component was observed between alkali treated and untreated samples. These results suggest that the combination of alkali treatment and irradiation is effective for digestion by enzyme. The analysis of products by HPLC after enzymatic degradation is useful method to examine the digestibility and the sugar composition of oil palm by-products. (author).

23177 (INIS-JP–007, pp. 614-619) **Formation of particle tracks in solids and their technological application.** Spohr, R. (Gesellschaft fuer Schwerionenforschung mbH, Darmstadt (Germany)). Japan Atomic Energy Research Inst., Tokyo (Japan). 1992. 817p. (CONF-911154–: International conference on evolution in beam applications, Takasaki (Japan), 5-8 Nov 1991). In *Proceedings of the international conference on evolution in beam applications.* Order Number DE93703820. Source: OSTI; NTIS; INIS.

The phenomenon of discrete, directed, and developable ion tracks opens the possibility to structure and modify materials with individual atomic particles on a mesoscopic scale at a high level of pre-determination. The depth and sharpness of this microtool foreshadows new stimuli for a variety of fields. The technique is based on the possibility to amplify a quasi one-dimensional damage zone - engraved by the passage of an ion through an insulating solid - chemically by several orders of magnitude - a key feature for the practical application of the technique. The report reviews the exploration of the technique and outlines its relevant properties applicable to materials science and microstructure technology: Basic features of ion tracks - creation of defects - enhancement and annealing - selective chemical etching - available parameters, Ion track applications - single pores - filtration and membranes - stimulus-responsive membranes - creation of anisotropy - heavy-ion lithography - surface texture - focussed ion beams. (author).

23178 (INIS-mf–13518, pp. ZJ13) **Radiation effects in glasses and crystals.** Prasil, Z. 1992. [76p.] (In Czech). (CONF-9210351–: The mining town of Pribram in science and technology, Pribram (Czechoslovakia), 12-14 Oct 1992). In *The mining town of Pribram in science and technology. Abstracts of contributions.* Order Number DE93625342. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. DIAMONDS/irradiation; ACCELERATORS; COLOR; CRYSTALS; DIAMONDS; IRRADIATION; PHYSICAL RADIATION EFFECTS

23179 (ORNL/FTR–4324) **[Travel relating to the Advanced Neutron Source project]: Foreign trip report, July 12–24, 1992.** West, C.D.; Zucker, A. Oak Ridge National Lab., TN (United States). 18 Aug 1992. 24p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93012406. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Collaboration between JAERI and ORNL on research and development is proceeding well, to the great benefit of the DOE program. Plans for destructive testing at Japan's Nuclear Safety Research Reactor of uranium silicide fuel miniplates are well advanced; these tests could not be done anywhere in the US Other important areas of work, including supercontainment design studies, were also discussed. Initial plans for a January 1993 review or steering group meeting on the R&D collaboration were discussed. Initial plans for the IGORR-II meeting in 1993 were also agreed.

23180 (ORNL/M–2711) **Ion implantation effects on surface-mechanical properties of metals and polymers.** Rao, G.R. Oak Ridge National Lab., TN (United States). Apr 1993. 207p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93014661. Source: OSTI; NTIS; GPO Dep.

Fatigue of 8 complex alloys based on Fe-13Cr-15Ni-2Mo-2Mn-0.2Ti-0.8Si- 0.06C, and single-crystal Fe-15Cr-15Ni, implanted with 400-keV B^+ and 550-keV N^+ (total dose 2.3×10^{16} ions/cm^2) was examined. 600 C creep was also examined. The dual implantation increased hardness but decreased fatigue life of the 8 complex alloys. An optimum strengthening level and a shift to grain boundary cracking were determined. The single crystals also showed reduced fatigue life after implantation. High temperature creep of E1 and B1 alloys were improved by the dual implantation. Four polymers (PE, polypropylene, polystyrene, polyethersulfone) were implanted with 200keV B^+ to 3 different doses. PS was also implanted with both B^+ and Ar^+. Near-surface hardness and tribological properties were measured. The hardness increased with dose and energy; wear also improved, with an optimum dose. (DLC)

23181 (SAND–93-0864C) **Si Atomic Layer Epitaxy based on Si_2H_6 and remote He plasma bombardment.** Mahajan, A. (Texas

Univ., Austin, TX (United States). Dept. of Electrical and Computer Engineering); Irby, J.; Kinosky, D.; Qian, R.; Thomas, S.; Banerjee, S.; Tasch, A.; Picraux, T. Sandia National Labs., Albuquerque, NM (United States). [1993]. 17p. Sponsored by USDOE, Washington, DC (United States); Department of Defense, Washington, DC (United States); National Science Foundation, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-920690–1: Atomic layer epitaxy, Raleigh, NC (United States), 3-5 Jun 1992). Order Number DE93011674. Source: OSTI; NTIS; GPO Dep.

We have demonstrated removal of H from a H-passivated Si(100) surface by low energy (~50 eV) He ion bombardment. The extent of the removal of H from the surface can be controlled by varying the duration of He bombardment and plasma parameters. This, in turn, means that the growth rate by this method can also be controlled. Si_2H_6 was shown to adsorb in a self-limiting manner on the Si(100) surface.

23182 (UCRL-JC–111802) **X-ray lasers as sources for x-ray microscopy.** MacGowan, B.J. Lawrence Livermore National Lab., CA (United States). Jul 1992. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-920792–60: Society of Photo-Optical Instrumentation Engineers (SPIE) international symposium on optical applied science and engineering, San Diego, CA (United States), 19-24 Jul 1992). Order Number DE93013420. Source: OSTI; NTIS; GPO Dep.

Laboratory x-ray lasers are currently being developed by researchers worldwide as potential sources for x-ray imaging and other applications. Laser action has been demonstrated at wavelengths as short as 35.6 A and there is a large effort underway to enhance the coherent power output of the Ni-like Ta x-ray laser at 44.83 A as a source for x-ray imaging of live cells. Part of this effort is dedicated to producing a more affordable, compact laser to pump the x-ray laser in order to increase the accessibility of x-ray laser sources.

0703 Isotopic Power Supplies

Refer also to citation(s) 23780

23183 (DOE/SF/18852–T25) **GPHS-RTGs in support of the Cassini mission: Semi annual technical report, 28 September 1992–28 March 1993.** Martin Marietta Astro Space, Philadelphia, PA (United States). [1993]. 51p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-91SF18852. Order Number DE93011911. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The technical progress achieved during the period 28 September 1992 through 28 March 1993 on Contract DE-AC03-91SF18852, Radioisotope Generators and Ancillary Activities is described herein. This report is organized by the program task structure as follows: spacecraft integration and liaison; engineering support; safety; qualified uncouple production; ETG fabrication, assemble, and test; ground support equipment (GSE); RTG shipping and launch support; designs, reviews, and mission applications; project management, quality assurance, reliability, contract changes, noncapital CAGO acquisition, and CAGO maintenance; and CAGO acquisition (capital funds).

0705 Health and Safety

23184 (NUREG/CR–5962) **Health and safety impacts from discrete sources of naturally-occurring and accelerator-produced radioactive materials (NARM).** Nussbaumer, D. (Advanced Systems Technology, Inc., Atlanta, GA (United States)); Wiblin, C.; Welch, L. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Regulatory Applications; Advanced Systems Technology, Inc., Atlanta, GA (United States). Feb 1993. 44p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). Source: OSTI; NTIS; INIS; GPO.

This report characterizes discrete sources of naturally-occurring and accelerator-produced radioactive material (NARM) and estimates risks posed by the possession, use and disposal of them. A distinction between discrete and diffuse NARM sources is made with discrete sources being high activity, low volume and diffuse sources being low activity, high volume. Two nanocuries per gram is used as a separation guide between high and low activity, although use of this value does not impact the report's conclusions. Most NARM is under regulatory control of States that either license or register users but reporting requirements are not uniform. Use in consumer products has declined with virtually no production today; however, lack of information available concerning radiation exposures resulting form possession of ageing radium sources precludes a quantitative risk assessment in this report. The report identifies the type of information needed to permit such an assessment. Regarding accelerator-produced radioactive material (ARM), use of this material in nuclear medicine programs has recently increased. Available radiation exposure data regarding ARM handling and use indicates that the risk to workers and the public is low at this time.

23185 (WSRC-MS–93-148) **Summary of the Savannah River Site Criticality Dosimetry Program.** Crase, K.W. Westinghouse Savannah River Co., Aiken, SC (United States). Feb 1993. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. (CONF-9306149–1: CED international nuclear accident dosimeter intercomparison conference, Dijon (France), 7-8 Jun 1993). Order Number DE93011708. Source: OSTI; NTIS; INIS; GPO Dep.

The mission of the Savannah River Site (SRS) includes working with fissionable materials. A program is in place, therefore, to assess neutron and gamma doses to individuals in the event of a criticality accident at SRS. The program consists of a method to quickly screen for potentially exposed personnel, a method to provide early but preliminary dose estimates, and a nuclear accident dosimeter and assay procedure to enable final dose estimates.

0706 Environmental Aspects

Refer also to citation(s) 24739

0707 Regulation and Licensing

Refer also to citation(s) 23184

08 HYDROGEN

23186 (DOE/FTR–93012984) **[Travel to Paris, France, to attend the 28th International Energy Agency Hydrogen Executive Committee meeting; to attend the 9th World hydrogen energy conference and present a paper on behalf of EPRI and Technology Transition, Inc.]: Foreign trip report, June 17–29, 1992.** Hoagland, W. National Renewable Energy Lab., Golden, CO (United States). 27 Jul 1992. 43p. Sponsored by USDOE, Washington, DC (United States); Electric Power Research Inst., Palo Alto, CA (United States). DOE Contract AC02-83CH10093. Order Number DE93012984. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Traveled to Paris, France, to attend the IEA Hydrogen Executive Committee Meeting on Friday, June 19th and during the following week attended the World Hydrogen Energy Conference to present a paper on "A Hydrogen to a Future Hydrogen Economy". W. Hoagland also attended the second meeting of the International Standards Organization Technical Committee 197 (ISO/TC197) to discuss required standards for widespread adoption of hydrogen for energy applications.

0801 Production

Refer also to citation(s) 23876

23187 (CONF-9207203–, pp. 43-46) **Synthesis of hydrocarbons from natural gas and carbon dioxide.** Yamazaki, O. (The University of Tokyo, Tokyo (Japan). Faculty of Engineering); Nozaki, T.; Omata, K.; Fujimoto, K. 22 Jul 1992. 320p. (In Japanese). From 1. meeting of The Japan Institute of Energy and the 70th Foundation anniversary meeting; Tokyo (Japan); 22-24 Jul 1992. In *Proceedings of the 1st Meeting of the Japan Institute of Energy and the 70th Foundation Anniversary Meeting.* Order Number DE93793523. Source: OSTI; NTIS (US Sales Only).

Study was made of two-stage reaction to produce synthesized gas by the CH4-CO2 reforming reaction in the first stage and synthesize liquid hydrocarbon by the Fischer-Tropsch (FT) method in the second stage. Carbon is deposited on the catalyst surface and the catalyst is therefore inactivated in case of nickel catalyst with alumina carrier in the reforming reaction, while nickel catalyst with high basicity MgO-CaO carrier is stably active for many hours even under a CH4-rich condition and produces synthesized gas of an almost equilibrated composition. The basic catalyst strongly adsorbs acidic compounds such as C2 and its surface is therefore covered with them so that the carbon deposition by surplus hydrogen picked out from CH4 is controlled, which mitigates the degradation in catalytic activity. Conventional ferrous catalyst is rapidly inactivated by the carbon deposition in the FT reaction where the base material is the synthesized gas after reformed at 1/1 in CO/H2 ratio. However, newly developed Co-La/SiO2 catalyst is stably active for many hours and gives a high selectivity to the liquid hydrocarbon synthesis. 3 refs., 4 figs.

23188 (DPW–4466) **[Travel to Amarillo Helium Plants to secure background information on helium handling and oil removal from compressed helium]: Trip report, January 16-17, 1952.** Cherney, B.J. Du Pont de Nemours (E.I.) and Co., Wilmington, DE (United States). 29 Jan 1952. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. (SR/H–462). Order Number DE93011157. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report details travel to Amarillo to secure background information on helium handling and oil removal from compressed helium.

0802 Storage, Transport, and Handling

Refer also to citation(s) 23188

23189 (Y/DZ–924) **Report on official foreign travel to Sweden and Germany, June 4–21, 1992.** Powell, G.L. Oak Ridge Y-12 Plant, TN (United States). 10 Jul 1992. 40p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OS21400. Order Number DE93013007. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Purpose of this trip was to participate in both the International Symposium on Metal-Hydrogen Systems, Fundamentals and Applications, Uppsala University, Uppsala, Sweden, June 7–12, 1992, and in technical discussions at the Institut fuer Festkorperforschung, Forschungszentrum (KFA), Juelich, Germany, June 15–17, 1992.

09 BIOMASS FUELS

23190 (DOE/FTR–93012254) **Travel to Florence, Italy to assess the state of the European (EEC) biomass to energy (bioenergy) program direction, and of the research and development advances in the recently completed Joule program: Foreign trip report, October 3–12, 1992.** Overend, R.P.; Bull, S.R. National Renewable Energy Lab., Golden, CO (United States). 11 Nov 1992. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-83CH10093. Order Number DE93012254. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The conference is a major review of the EEC programs with very little non-EEC participation. The format is to have plenary discussion papers, some technical oral papers (Bull made a presentation entitled "Strategies for Biomass Implementation: Alliance Between Government and Industry") and in addition a lot of poster papers (Bull presented a poster entitled Total Fuel Cycle Environmental Outputs of Biomass to Ethanol Production) by individual researchers. There are workshops (Overend chaired one on biofuels development) and time for extensive discussion of technology and policy. The technologies and science displayed were on par with those ongoing in the USA, In the crop production program, there are a series of centers that pay attention to crops such as sorghum and miscanthus, which are not in the US program to any great extent. In conversion technologies the emphasis is on the use of existing agricultural crops such as sugar beet and oilseeds to manufacture ethanol and biodiesel respectively. These products do not require much R&D at this stage and the EEC has announced a policy of de-taxation that will have a major impact on the alternative fuels market place. The major R&D thrust is in electricity production - mostly through the biocrude oil route. There are three pilot plant or scaleups in progress, and there is extensive laboratory research on off properties and upgrading. In addition, the Italian Utility, ENEL, is undertaking a closed cycle biomass demonstration that incorporates sorghum production on 75 ha, and its conversion into a biocrude using Canadian technology - the biocrude will be used to co-fire an existing utility boiler. Biomass funding in Europe is likely to increase significantly in the next few years and the meeting gave a clear set of directions that will be followed and these are discussed in the report.

0907 Resources

Refer also to citation(s) 23206, 23209, 23218, 23227, 24867

23191 (CONF-921276–, pp. 275-278) **Production of tall-golden-rod in Hamamatsu city.** Imoto, I. 3 Dec 1992. 305p. (In Japanese). From 1992 Japan Solar Energy Society, Japan Wind Energy Association joint converence; Osaka (Japan); 3-4 Dec 1992. In *1992 JSES (Japan Solar Energy Society)/JWEA (Japan Wind Energy Association) Joint Conference*. Order Number DE93793955. Source: OSTI; NTIS (US Sales Only).

Tall-golden-rod (TGR) which serves as a natural energy source was investigated in production status in Hamamatsu City. The production quantity was indirectly assumed from the product of production quantity per unit area (dry weight density) multiplied by the area of plant community portion (vegetation-covered area) as surveyed by ranging over. The dry weight of taller stalks than 10cm above the ground was considered to be the production quantity. The city was divided into 1056 sections each of which is 500m in north-south distance by 400m in east-west distance. Among those sections, 32 ones were surveyed at random. The ratio of the area, in which the number of existing taller stalks than 1.2m was more than one per spuare meter, to the whole area of the said section was considered to be the vegetation-covered ratio. The production quantity by Hamamatsu City attained to 750 (370 to 1140) tons in 1991. The histogram of logarithm of the above ratio gave a normal distribution. That ratio is high on the agricultural land and the TGR is more propagative than the large weeds. The production quantity attained to 3.24kg/m^2 at the largest in the place abundant in water and nutriment. The logarithm of product of the heaviest dry weight multiplied by the number of stalks within one square meter (M) is positively correlative with the logarithm of dry weight density (W). Therefore, it is effective as well as simple to obtain the W and assume the production quantity by using the M which can be simply measured. 5 refs., 6 figs., 2 tabs.

0908 Production

Refer also to citation(s) 23216

23192 (CONF-9211101–10) **New switchgrass biofuels research program for the Southeast.** McLaughlin, S.B. Oak Ridge National Lab., TN (United States). [1992]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From Annual automotive development technology contractors' coordination meeting; Dearborn, MI (United States); 2-5 Nov 1992. Order Number DE93012764. Source: OSTI; NTIS; GPO Dep.

The Biofuels Feedstock Development Program (BFDP) has selected a perennial crop, switchgrass, Panicum virgalum, as a model species for further development as a biofuels feedstock. The selection of switchgrass was based on several significant attributes, including its demonstrated high productivity across a wide geographical range, suitability for marginal quantity land, low water and nutrient requirements, and positive environmental attributes. A series of six research projects was initiated in 1992 to pin important new information on the yield potential of this species as a biofuels crop. These projects are evaluating the most promising existing varieties in regional field trials, cultural treatments to enhance the establishment and growth of stands, breeding for superior

yield, identification of physiological markers for assessing and promoting improved growth and development, and the development of tissue culture techniques for biotechnological improvement. These tasks combine the interrelated needs of realizing maximum near-term pins in productivity potential through cultural improvement and the longer term requirements for enhancing and protecting yield capacity.

23193 (NEI-DK–1168) **Full scale management of straw: Partial report 1. Gathering and stacking of straw.** Astrupgaard, N.P.; Stenholm, M. Dk-TEKNIK, Soeborg (Denmark). Energi og Miljoe. Mar 1993. [50p.] (In Danish). Contract ENS-51161-92.0046. Order Number DE93794694. Source: OSTI; NTIS.

An investigation was carried out of the steps in the processes carried out in the field concerning cutting and stacking of straw which is to be used as fuel in district heating plants. The preparation of 14 of 25 stacks on Lolland, Falster and Zealand (Denmark) was followed minutely. Five different commercial types of cutting machinery, two of which were self-propelling, were used. Measurement of moisture content, load weight, time taken for cutting and loading, transport and unloading, and netto and brutto capacity reckoned in tons per hour etc. were carried out in relation to each kind of equipment. All results are presented in detail. It is concluded that straw should be stacked continuously in connection with baling. It was found that the amount of work was 9% less with cut than with baled straw. Prices asked by the various firms who provided, worked and drove the various machines are also given. (AB).

0909 Processing

Refer also to citation(s) 24822, 24841, 24843

23194 (CONF-9207203–, pp. 215-218) **Thermochemical conversion of cellulose with nickel metal catalyst.** Minowa, T. (National Institute for Resources and Environment, Tsukuba (Japan)); Ogi, T.; Yokoyama, S. 22 Jul 1992. 320p. (In Japanese). From 1. meeting of The Japan Institute of Energy and the 70th Foundation anniversary meeting; Tokyo (Japan); 22-24 Jul 1992. In *Proceedings of the 1st Meeting of the Japan Institute of Energy and the 70th Foundation Anniversary Meeting*. Order Number DE93793523. Source: OSTI; NTIS (US Sales Only).

With an objective of converting cellulose to hydrocarbon to develop a biomass utilizing method, discussions were given on reaction of cellulose under high temperature and pressure with presence of water, using nickel metal catalysts. The nickel metal catalysts used included two kinds of commercially available catalysts and four kinds of prepared catalysts. One gram of material cellulose and 0.5 g of Ni catalyst are placed in an autoclave, displaced of N2 stirred and heated under an initial pressure of 2 MPa to predetermined temperatures (350°C), 400°C, and then retained for 30 minutes. The produced gas was low-grade hydrocarbon with a carbon number from 1 to 5. The reactions at 350°C with and without the catalysts resulted in gasification rates of 15.5% → 17% → 49% and hydrocarbon producing rates of 0.8% → 1.8% → 5.9%, indicating the catalytic effect. Adding alkali metal salt into the reaction system as an auxiliary catalyst caused these rates to either improve or reduce depending kinds of the catalyst. 4 refs., 1 tab.

23195 (DOE/ER/13255–9) **[Hydroxyproline: Rich glycoproteins of the plant and cell wall]: Annual technical progress report, 1993.** Varner, J.E. Washington Univ., St. Louis, MO (United States). 1993. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-84ER13255. Order Number DE93014842. Source: OSTI; NTIS; GPO Dep.

Since xylem tissue includes the main cell types which are lignified, we are interested in gene expression of glycine-rich proteins and proline-rich proteins, and other proteins which are involved in secondary cell wall thickening during xylogenesis. Since the main feature of xylogenesis is the deposition of additional wall components, study of the mechanism of xylogenesis will greatly advance our knowledge of the synthesis and assembly of wall macromolecules. We are using the in vitro xylogenesis system from isolated Zinnia mesophyll cells to isolate genes which are specifically expressed during xylogenesis. We have used subtractive hybridization methods to isolate a number of cDNA clones for differentially regulated genes from the cells after hormonal induction. So far, we have partially characterized 18 different cDNA clones from 239 positive clones. These differentially regulated genes can be divided into three sets according to the characteristics of gene expression in the induction medium and the control medium. The first set is induced in both the induction medium and the control medium without hormones. The second set is induced mainly in the induction medium and in the control medium with the addition of NAA alone. Two of thesegenes are exclusively induced by auxin. The third set of genes is induced mainly in the induction medium. Since these genes are not induced by either auxin or cytokinin alone, they may be directly involved in the process of xylogenesis. Our experiments on the localization of H_2O_2 production reinforce the earlier ideas of others that H_2O_2 is involved in normal lignification.

23196 (DOE/ER/13370–T2) **[Conversion of acetic acid to methane by thermophiles]: Progress report, May 15, 1989–May 14, 1993.** Zinder, S.H. Cornell Univ., Ithaca, NY (United States). [1993]. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-85ER13370. Order Number DE93014433. Source: OSTI; NTIS; GPO Dep.

The primary goal of this project is to obtain a better understanding of thermophilic microorganisms which convert acetic acid to CH_4. The previous funding period represents a departure from earlier research in this laboratory, which was more physiological and ecological. The present work is centered on the biochemistry of the thermophile Methanothrix sp. strain CALS-1. this organism presents a unique opportunity, with its purity and relatively rapid growth, to do comparative biochemical studies with the other major acetotrophic genus Methanosarcina. We previously found that Methanothrix is capable of using acetate at concentrations 100 fold lower than Methanosarcina. This finding suggests that there are significant differences in the pathways of methanogenesis from acetate in the two genera.

23197 (DOE/ER/13717–3) **Role of proteolytic enzymes in degradation of plant tissues: Summary of results of studies completed on the prior.** Lewosz, J.; Kelman, A.; Sequeira, L. Wisconsin Univ., Madison, WI (United States). Dept. of Plant Pathology. [1991]. 2p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-87ER13717. Order Number DE93015740. Source: OSTI; NTIS; GPO Dep.

Strain SR 394 of Erwinia carotovora (Ecc) produced proteases constitutively in all media tested. Growth of Ecc and production of protease were enhanced significantly by the presence of poetic materials and/or plant call walls in the test media. After electrofocusing, one major and one minor protease bands, at PI 4.8 and PI 5.1, respectively, were detected. Only one band of 43 kDa was detected on SDS gels. Only one protease band was detected in SDS gels of infected plant extracts. This protease was purified to homogeneity. It in a highly thermostable metal protease; it degrades gelatin, soluble collagen and hide powderazure, shows weak activity on casein and azocasein, but does not degrade insoluble collagen or elastin.

23198 (NEI-DK–1149) **Collective biogas plants: European experience in combined manure and waste processing. Proceedings.** Commission of the European Communities, Brussels (Belgium). Directorate General for Energy; Energy Centre Denmark, Copenhagen (Denmark). 1992. 249p. (CONF-9210360–: European seminar on collective biogas plants. European experience in combined manure and waste processing, Herning (Denmark), 22-23 Oct 1992). Order Number DE93794674. Source: OSTI; NTIS; INIS.

A THERMIE Programme Action.

Papers contributed to the European seminar on collective biogas plants held at Herning, Denmark on October 22-23 under the auspices of the Commission of the European Communities, Directorate-General for Energy (DG XVII) are presented. Within the framework of the THERMIE programme, a network of OPETs (Organizations for the Promotion of Energy Technologies) was set up in order to disseminate information on new energy technologies throughout the European communities. The potential for further implementation of centralized capacity for the conversion of animal manures and other organic wastes to bio-fuels, not only in central

and eastern Europe but also in the developing countries, is discussed in addition to the relevant technologies. Actual biomass conversion plants are described and details are given on operational experience and plant management. Agricultural, economic and policy aspects are also dealt with. (AB).

23199 (NEI-DK–1149, pp. 11-27) **State-of-the-art of large scale biogas plants.** Prisum, J.M. (Krueger Bigadan A/S, Soeborg (Denmark)); Noergaard, P. Commission of the European Communities, Brussels (Belgium). Directorate General for Energy; Energy Centre Denmark, Copenhagen (Denmark). 1992. (CONF-9210360–: European seminar on collective biogas plants. European experience in combined manure and waste processing, Herning (Denmark), 22-23 Oct 1992). In *Collective biogas plants: European experience in combined manure and waste processing. Proceedings.* 249p. Order Number DE93794674. Source: OSTI; NTIS.

A THERMIE Programme Action.

A survey of the technological state of large scale biogas plants in Europe treating manure is given. 83 plants are in operation at present. Of these, 16 are centralised digestion plants. Transport costs at centralised digestion plants amounts to between 25 and 40 percent of the total operational costs. Various transport equipment is used. Most large scale digesters are CSTRs, but serial, contact, 2-step, and plug-flow digesters are also found. Construction materials are mostly steel and concrete. Mesophilic digestion is most common (56%), thermophilic digestion is used in 17% of the plants, combined mesophilic and thermophilic digestion is used in 28% of the centralised plants. Mixing of digester content is performed with gas injection, propellers, and gas-liquid displacement. Heating is carried out using external or internal heat exchangers. Heat recovery is only used in Denmark. Gas purification equipment is commonplace, but not often needed. Several plants use separation of the digested manure, often as part of a post-treatment/-purification process or for the production of 'compost'. Screens, sieve belt separaters, centrifuges and filter presses are employed. The use of biogas varies considerably. In some cases, combined heat and power stations are supplying the grid and district heating systems. Other plants use only either the electricity or heat. (au).

23200 (NEI-DK–1149, pp. 31-40) **Results of a demonstration project: The Marsciano cooperative plant.** Poli, F. De (ENEA, Roma (Italy)). Commission of the European Communities, Brussels (Belgium). Directorate General for Energy; Energy Centre Denmark, Copenhagen (Denmark). 1992. (CONF-9210360–: European seminar on collective biogas plants. European experience in combined manure and waste processing, Herning (Denmark), 22-23 Oct 1992). In *Collective biogas plants: European experience in combined manure and waste processing. Proceedings.* 249p. Order Number DE93794674. Source: OSTI; NTIS.

A THERMIE Programme Action.

A consortial (cooperative) plant for the treatment of pig wastes was built in The Marsciano area (Perugia, Italy). The system was designed to recover all the available resources, both in terms of energy and in terms of materials. It is composed of an anaerobic digestion system (CSTR reactor, 15,000 m^3 working volume), producing over 20,000 m^3 of biogas/day, and a number of biogas operating devices (generators of electricity and heat, hay and crop dryer, tobacco dryer, greenhouses), that make all the biogas to be utilized with profit. The solid fraction of digested effluent is sold as fertilizer, the liquid is stored in lagoons for 9 months, and utilized during summer for fertilizing irrigation. The environmental problems of the area, both water pollution and odour emission, were completely solved with a low cost for the farmers, and the Municipality is likely to allow the realization of new pig farms. (au).

23201 (NEI-DK–1149, pp. 42-48) **Operational experinece with large scale biogas production at the promest manure processing plant in Helmond, the Netherlands.** Schomaker, A.H.H.M. (Haskoning, Royal Dutch Consulting Engineers and Architects, Nijmegen (Netherlands)). Commission of the European Communities, Brussels (Belgium). Directorate General for Energy; Energy Centre Denmark, Copenhagen (Denmark). 1992. (CONF-9210360–: European seminar on collective biogas plants. European experience in combined manure and waste processing, Herning (Denmark), 22-23 Oct 1992). In *Collective biogas plants: European experience in combined manure and waste processing. Proceedings.* 249p. Order Number DE93794674. Source: OSTI; NTIS.

A THERMIE Programme Action.

In The Netherlands a surplus of 15 million tons of liquid pig manure is produced yearly on intensive pig breeding farms. The dutch government has set a three-way policy to reduce this excess of manure: 1. conversion of animal fodder into a product with less and better ingestible nutrients; 2. distribution of the surplus to regions with a shortage of animal manure; 3. processing of the remainder of the surplus in large scale processing plants. The first large scale plant for the processing of liquid pig manure was put in operation in 1988 as a demonstration plant at Promest in Helmond. The design capacity of this plant is 100,000 tons of pig manure per year. The plant was initiated by the Manure Steering Committee of the province Noord-Brabant in order to prove at short notice whether large scale manure processing might contribute to the solution of the problem of the manure surplus in The Netherlands. This steering committee is a corporation of the national and provincial government and the agricultural industrial life. (au).

23202 (NEI-DK–1149, pp. 49-54) **Waste water treatment plant in Trebon.** Kajan, M. (COV (Czechoslovakia)). Commission of the European Communities, Brussels (Belgium). Directorate General for Energy; Energy Centre Denmark, Copenhagen (Denmark). 1992. (CONF-9210360–: European seminar on collective biogas plants. European experience in combined manure and waste processing, Herning (Denmark), 22-23 Oct 1992). In *Collective biogas plants: European experience in combined manure and waste processing. Proceedings.* 249p. Order Number DE93794674. Source: OSTI; NTIS.

A THERMIE Programme Action.

A biomass conversion plant in Trebon, Czech Republic, aerobically digests municipal sewage wastes and pig manures. The plant includes aeration and settling tanks and a stabilization pond in order to deal with increasing supplies of sewage delivered by pumps from the town. The operation of the plant is briefly described. The liquid phase, after reduction of ammonia, is either retreated aerobically or used as fertilizer in fishponds or on fields. Experiments with waste water treatment using photoautotrophic microorganisms and production of biohumus from solid waste by vermis cultures are in progress. (AB).

23203 (NEI-DK–1149, pp. 56-64) **Sinding-Oerre biogas plant.** Moeller, H.B. (Herning Municipal Utilities (Denmark)); Bertelsen, F. Commission of the European Communities, Brussels (Belgium). Directorate General for Energy; Energy Centre Denmark, Copenhagen (Denmark). 1992. (CONF-9210360–: European seminar on collective biogas plants. European experience in combined manure and waste processing, Herning (Denmark), 22-23 Oct 1992). In *Collective biogas plants: European experience in combined manure and waste processing. Proceedings.* 249p. Order Number DE93794674. Source: OSTI; NTIS.

A THERMIE Programme Action.

Herning Municipal Utilities has in 1988 constructed a full scale biogas plant for digestion of animal manure and industrial wastes. The plant receives manure from 40 farmers and wastes from several different kinds of industries - about 50,000 tons of raw materials are received each year. The material is digested thermophilic (at 53 deg. C) and since 1990 the gas yield has been high. In 1992 the average gasproduction has been about 6,000 m^3 per day. The gas is used for producing electricity and heat in three gasmotors. The heat is used for district heating and for process heating. Since the end of 1991 a new pilot plant for digestion of source separated household waste and liquid manure in combination is runned parallel to the existing plant. The treatment consists of pretreatment, digestion and postreatment of 1,000 tons of source separated organic household waste mixed with liquid manure in the ratio 1:4. So far the results seem very promising. The gasproduction is about 130 Nm^3 biogas per ton household waste and the produced fertilizer product is clean and with content of heavy metals below the limit value. The amount of material lost by separation is very low, less than 8 percent of the received household waste. (au).

23204 (NEI-DK–1149, pp. 227-242) **Current status and prospects of biogas-biomanure production in Hungary.** Bartha, I. (NOVA Industrial Servicing Workteam Association, Budapest

(Hungary)); Heredy, S. Commission of the European Communities, Brussels (Belgium). Directorate General for Energy; Energy Centre Denmark, Copenhagen (Denmark). 1992. (CONF-9210360--: European seminar on collective biogas plants. European experience in combined manure and waste processing, Herning (Denmark), 22-23 Oct 1992). In *Collective biogas plants: European experience in combined manure and waste processing. Proceedings.* 249p. Order Number DE93794674. Source: OSTI; NTIS.

A THERMIE Programme Action.

In Hungary, the implementation of biomass conversion using manures began during the nineteen-sixties and at this time much research was carried out in this field. The present deficiency in the relative equipment is due to political factors. Current calculations imply that 56 PJ per year can be generated from the total available biomass in Hungary, and that the semi-dry procedure is most suitable. Presently, agricultural wastes are now either burnt up or ploughed down after chopping and supplementing with fertilizers. An innovative semi-dry procedure of aerobic conversion is explained in detail and complex diagrams illustrate the text. The advantages of its use are that little energy is used for bringing the fermentation temperature up to the required level, operation is easy and flexible and the fermentors can be started up at any time and do not need a running-in period. The environmental advantages of using this system are many. The resulting manure waste from this form of aerobic conversion is not liquid and is more nutritious as a fertilizer. It is claimed that there is much interest in Hungary in establishing this type ofbiomass conversion and patents have been given and are applied for, but the country, because of past political problems, needs economical help for implementation. (AB).

23205 (NEI-DK–1180) **Handling of household wastes which are sorted at the source in preparation for energy and fertilizer production in collective biomass conversion plants.** Herning Kommunale Vaerker (Denmark). 1993. 101p. (In Danish). Contract ENS-51161-91.0010. Order Number DE93794761. Source: OSTI; NTIS.

At a test-plant located in Sinding-Oere, Denmark, the aim was to mix particles of household food wastes with liquid manures to a suitable consistency. The resulting material was treated for one hour at a temperature of 70 degrees centigrade so that it should not constitute any hazards to health and then subjected to digestion at thermophile process temperatures. A traditional slurry separator was used to sort out undesirable materials such as plastics. Stones, metals etc. were removed by sedimentation in the fore-tank. Although some technical problems arose, the final product was without unwanted materials and had an acceptable heavy metal content and hygienic standard. The amount of unwanted, separated material was only 8% of the total amount of received household wastes. The production of methane was satisfactory when compared with the quality of the wastes, and amounted to ca. 120 cubic meters per ton of wastes. In the fore-tank the sediment of stones, glass etc. was minimum 10%. Some technical alterations are necessary, especially with regard to preliminary processing, and other modifications should be carried out in relation to other processes. The quality of the sorted household wastes should be discussed as garden wastes and inadequate sorting at the sources substantially increases processing costs. (AB).

0920 Combustion

Refer also to citation(s) 22770

23206 (ETDE-mf–93795223) **Research into the energetic utilization of biomass.** Thiem, U. Noell GmbH, Wuerzburg (Germany); Ministerium fuer Ernaehrung, Landwirtschaft und Forsten des Landes Niedersachsen, Hannover (Germany). Sep 1990. 178p. (In German). Order Number DE93795223. Source: OSTI; NTIS (US Sales Only).

Within the framework of the study, the use of biomass as a fuel in fluidized bed furnaces was investigated because this combustion system stands out by high flexibility regarding low-grade fuels. As a first step towards the design of a fluidized combustion system, fuel-technological aspects were studied. It was found that the entire plants, which have on average calorific value of 17000 kJ/kg dry substance, can be burnt even if they have a higher water content. The design concept for a power plant with a thermal capacity of 30 megawatts comprises a stationary fluidized bed furnace with external ash recirculation as a robust and flexible combustion system. The hot, ash-laden flue gas is routed via a cyclone. The precipitated ash is fed back into the combustion chamber via a fluidized bed cooler while the flue gas is supplied to the boiler for power and heat generation. Cogeneration is indispensable to ensure optimum energy utilization. Including roads, the plant requires an area of some 6300 m^2. (orig./EF).

23207 (NEI-DK–1171) **Biomass in scattered buildings: Experience gained, status and preparation of demonstration projects.** Dk-Teknik, Soeborg (Denmark); Ramboell, Hannemann og Hoejlund A/S, Copenhagen (Denmark). Apr 1993. 118p. (In Danish). Contract ENS-51161-92.0005. Order Number DE93794756. Source: OSTI; NTIS; INIS.

A survey of experience gained of technological, organisational and economical aspects of earlier Danish projects related to smaller straw and wood-chip fired plants on which the presented recommendations for carrying out new demonstration projects are based. An individual project, based at Langebaek, Denmark, where straw-pellet fuelled plants were installed in various homes is judged as successful although several technical and organisational problems remain to be solved. A project involving wood-fuelled domestic boilers and district heating plant in Kil, Sweden is also evaluated. The current status regarding combustion properties, distribution equipment, storage at the consumers, transport from the storage facility to the boiler, the combustion system and aspects of environmental protection is surveyed. Model calculations are carried out to illustrate the economical aspects of the use of straw and wood chip fuels, and these are evaluated and compared to individual oil-firing of domestic boilers. Ideas for ways of spreading the use of biomass fuels in private homes are presented. It is suggested that related technology and the potential consumer's knowledge of straw and wood fuels is at present limited and that more demonstration projects are needed. Local authorities and firms should be included in these activities and consultancy services should be increased. The assurance of a stable supply of these fuels presents a current problem and transport to, and storage at, the consumer should be better organized. Straw and wood fuels are cheaper to use than oil yet initiating government subsidies will be necessary for the consumer. (AB) (28 refs.).

0930 Economic, Industrial, and Business Aspects

Refer also to citation(s) 23200

23208 (NEI-DK–1149, pp. 130-143) **The commercialization of biogas production.** Christensen, J. (Institute of Agricultural Economics, Copenhagen (Denmark)). Commission of the European Communities, Brussels (Belgium). Directorate General for Energy; Energy Centre Denmark, Copenhagen (Denmark). 1992. (CONF-9210360--: European seminar on collective biogas plants. European experience in combined manure and waste processing, Herning (Denmark), 22-23 Oct 1992). In *Collective biogas plants: European experience in combined manure and waste processing. Proceedings.* 249p. Order Number DE93794674. Source: OSTI; NTIS.

A THERMIE Programme Action.

Currently there are ten large collective biogas plants and ten smaller farm plants operating in Denmark. During the last five years, biogas technology has undergone extensive technological development. The developmental process is supported by a public R and D programme and a follow-up programme for full-scale demonstration plants. Most plants still need considerable income increases before a final conclusion can be reached as to whether it is possible to achieve a profit from a corporate economic viewpoint. All plants have received investment grants. Gas production is in most cases reliable, especially due to the admixture of easily convertible organic waste as a supplement to the slurry supplies. Profitable collective biogas plants are within reach, even without investment grants. The total intake of biomass must be supplemented by 10 to 25 per cent easily convertible organic waste so that the minimum gas production reaches 30 to 35 m^3 per m^3 of biomass. Plants based solely on animal manure are not profitable.

Energy from the biogas has to be sold at prices corresponding to consumer prices, which include Danish energy taxes. Collective biogas plants in Denmark appear to be approaching a commercial breakthrough. The concept of a collective biogas plant has been developed to address the energy-related, environmentally-related and agricultural problems. (AB).

0940 Transport, Handling, and Storage

Refer also to citation(s) 23199, 23203, 23207

23209 (NEI-DK–1142) **New concepts for biogas: A biomass conversion plant in Skals.** Skadborg, O.; Thostrup, P.; Vistrup, E.; Larsen, J.E. Viborgegnens Energi- og Miljoekontor, Viborg (Denmark); Bioplan Miljoekonsulenter ApS, Viborg (Denmark); Cowiconsult Raadgivende Ingenioerer A/S, Viborg (Denmark). 1992. 120p. (In Danish). Contract ENS-51161-91.0014. Order Number DE93794677. Source: OSTI; NTIS.

Potentials for setting up a biomass conversion plant near Skals district heating plant in Denmark are discussed. 19 farms producing a total of 25,700 tons of manure per year would supply the plant in addition to 4,300 tons of other biomass. Four models for the number of plants and transport of biomass were considered. The aim was to reduce the volume of road transport of manures to the plants, to propose plans for the transmission of the methane to Skals district heating plant and to gain information on technological and economical aspects on which decision-making could be based. Possibilities of providing employment for some of the local inhabitants were also considered to be of relevance to the project. The system models are described in detail in addition to the use and possible prices of the methane used in local heat production. Aspects of financing, organization and local administrative procedures are also dealt with. (AB).

0950 Environmental Aspects

Refer also to citation(s) 23198, 23199, 23200, 23201, 23207, 24567

23210 (NEI-DK–1149, pp. 220-226) **Promotion and marketing of the biogas way.** Mistry, P.B. (Biotechnology Department, B353, AEA Technology, Harwell, Oxfordshire (United Kingdom)); Lindboe, H.H. Commission of the European Communities, Brussels (Belgium). Directorate General for Energy; Energy Centre Denmark, Copenhagen (Denmark). 1992. (CONF-9210360–: European seminar on collective biogas plants. European experience in combined manure and waste processing, Herning (Denmark), 22-23 Oct 1992). In *Collective biogas plants: European experience in combined manure and waste processing. Proceedings.* 249p. Order Number DE93794674. Source: OSTI; NTIS.

A THERMIE Programme Action.

The biological process of anaerobic digestion is used primarily as a tool for waste treatment. It also produces energy in the form of biogas - a feature by which it is often called the biogas technology. This paper outlines special features of this process, together with other advantages and disadvantages of applying the AD or the biogas technology, to satisfy ever increasing regulatory requirements and public concerns over pollution at both global and local levels. The paper then gives suggestions which could be implemented at the Commission, national and regional levels to propagate the implementation of the biogas technology. (au).

0960 Health and Safety

23211 (NEI-DK–1149, pp. 93-107) **Pathogens in biomas.** Bendixen, H.J. (The Danish Veterinary Service, Copenhagen (Denmark)). Commission of the European Communities, Brussels (Belgium). Directorate General for Energy; Energy Centre Denmark, Copenhagen (Denmark). 1992. (CONF-9210360–: European seminar on collective biogas plants. European experience in combined manure and waste processing, Herning (Denmark), 22-23 Oct 1992). In *Collective biogas plants: European experience in combined manure and waste processing. Proceedings.* 249p. Order Number DE93794674. Source: OSTI; NTIS.

A THERMIE Programme Action.

The author, a veterinary surgeon, deals in detail with the occurrence of pathogens in manures, also with regard to their use in biomass conversion plants. Hazards to health, in the form of disease risks, are pointed out in relation to transporting manures from the sources to the conversion plants, processing them for methane production and spreading the by-products out on the fields as fertilizers afterwards. Suggestions are given for safeguards against the dissemination of pathogens in these respects, also in connection with sanitation of organic matter during processing. Tables giving details of pathogens that regularly occur in manures in Denmark, decimation and inactivation times, the influence of various stabilizing treatments in salmonella bacteria and eggs of Taenia sagninata insludge, and hygienic conditions for the use of waste as stipulated by the Danish Ministry of the Environment, are presented. (AB) (14 refs.).

0990 Products and By-Products

Refer also to citation(s) 23198, 23202

10 SYNTHETIC FUELS

1002 Production

Refer also to citation(s) 22675, 22686, 22858

23212 (CONF-9207203–, pp. 231-232) **Synthesis of light hydrocarbons from synthesis gas using activated carbon-supported catalysts.** Sasada, G. (Osaka University, Osaka (Japan). Faculty of Engineering); Miura, M.; Nomura, M. 22 Jul 1992. 320p. (In Japanese). From 1. meeting of The Japan Institute of Energy and the 70th Foundation anniversary meeting; Tokyo (Japan); 22-24 Jul 1992. In *Proceedings of the 1st Meeting of the Japan Institute of Energy and the 70th Foundation Anniversary Meeting.* Order Number DE93793523. Source: OSTI; NTIS (US Sales Only).

Discussions were given on effects of average pore radius in supports and total pore volume on catalyst activity and product distribution in an FT reaction characteristics of iron catalysts using activated carbon as the support of which high dispersion loading is expected. Iron carbonyl or iron nitrate was impregnated and loaded in three kinds of activated carbon supports. The reaction was carried out using a fixed bed flow reactor under a time factor (W/F) of 20 g-h/mol, a temperature of 553 K, a pressure of 15 kg/cm^2 and H2/CO = 1.5. Catalysts using activated carbon with medium pore radius and volume resulted in an identical CO conversion rate and product distribution either in iron carbonyl or iron nitrate loaded catalyst. Comparing three kinds of supports of iron carbonyl metal origin, recognized is no correlation with sulfur residue or specific surface area of the catalyst with respect to the CO conversion rate and the hydrocarbon yield, but noticeable increase is observed with increasing pore radius and volume. 3 refs., 2 tabs.

23213 (DOE/MC/27225–3344) **Biological conversion of synthesis gas: Project status report, January 1, 1993–March 31, 1993.** Clausen, E.C. Arkansas Univ., Fayetteville, AR (United States). 10 Apr 1993. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG21-90MC27225. Order Number DE93013990. Source: OSTI; NTIS; GPO Dep.

A continuous stirred tank reactor with and without sulfur recovery has been operated using Chlorobium thiosulfatophilum for the conversion of H_2S to elemental sulfur. In operating the reactor system with sulfur recovery, a gas retention time of 40 min was required to obtain a 100 percent conversion of H_2S to elemental sulfur. Essentially no SO_4^{2-}, an undesirable product, was produced under these conditions. Significant reductions in the gas retention time are expected by employing cell recycle after sulfur recovery, and by using increased pressure.

23214 (DOE/PC/89786–T16) **A novel process for methanol synthesis: Progress report, December 1, 1992–February 28, 1993.** Tierney, J.W.; Wender, I. Pittsburgh Univ., PA (United States). Dept. of Chemical and Petroleum Engineering. [1993]. 14p. Sponsored by USDOE, Washington, DC (United States). DOE

Contract FG22-89PC89786. Order Number DE93014951. Source: OSTI; NTIS; GPO Dep.

A bench-scale reactor is being used to conduct studies of the conversion of synthesis gas to methanol in the liquid phase by a novel process. In previous reports, we provided evidence for a two step reaction in series, the carbonylation reaction mainly taking place close to the copper chromate surface, and the hydrogenolysis reaction taking place on the surface of the copper chromate. The interaction between thetwo catalysts enhances the rate of MeOH formation. we have previously shown that under present operating conditions, the methyl formate concentration is not in equilibrium. The presence of H_2O results in a drop in the rate of MeF generation by the carbonylation reaction. In this quarter, we examined schemes to reduce the H_2O level in the reactor and enhance the rate of MeF formation. An increased methyl formate concentration would lead to increased methanol synthesis rates.

23215 (DOE/PC/90043–T8) **Novel approaches to the production of higher alcohols from synthesis gas: Quarterly Technical progress report No. 8, July 1, 1992–September 30, 1992.** Roberts, G.; Kow, S. North Carolina State Univ., Raleigh, NC (United States). Dept. of Chemical Engineering. 14 Apr 1993. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-90PC90043. Order Number DE93014952. Source: OSTI; NTIS; GPO Dep.

A detailed technical plan for research on higher-alcohol synthesis in a slurry reactor was prepared and approved internally, as part of the University's requirements for the doctoral degree. The focus of this plan is the high-pressure methanol synthesis catalyst, and modifications thereof. A major challenge of the research will be to identify a slurry medium that is stable at the typical operating temperature ofthis catalyst, i.e., about 400°C. Two shakedown runs were made in the stirred autoclave without catalyst in order to check the mechanical operation of the system and to test some of the analytical equipment. Further preparation, characterization and screening of higher-oxygenate synthesis catalysts based on rhodium were carried out. The catalyst compositions tested during the period were: Rh/Al_2O_3, $Rh/Nb/Al_2O_3$, $Mo/Rh/Al_2O_3$ and $W/Rh/Al_2O_3$. All catalysts contained a nominal 1 wt. % Rh. $Rh/Nb/Al_2O_3$ and $Rh/Mo/Al_2O_3$ were about twice as active for COconversion as the other catalysts. However, oxygenate yields were disappointing for all of the compositions tested. The $Rh/Mo/Al_2O_3$ catalyst had the highest carbon efficiency to oxygenates, 33%.

23216 (NREL/TP–421-5150) **Status and future opportunities for conversion of synthesis gas to liquid energy fuels: Final report.** Mills, G. (Delaware Univ., Newark, DE (United States). Center for Catalytic Science and Technology). National Renewable Energy Lab., Golden, CO (United States); Delaware Univ., Newark, DE (United States). Center for Catalytic Science and Technology. May 1993. 187p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-83CH10093. Order Number DE93010025. Source: OSTI; NTIS; GPO Dep.

The manufacture of liquid energy fuels from syngas (a mixture of H_2 and CO, usually containing CO_2) is of growing importance and enormous potential because: (1) Abundant US supplies of coal, gas, and biomass can be used to provide the needed syngas. (2) The liquid fuels produced, oxygenates or hydrocarbons, can help lessen environmental pollution. Indeed, oxygenates are required to a significant extent by the Clean Air Act Amendments (CAAA) of 1990. (3) Such liquid synfuels make possible high engine efficiencies because they have high octane or cetane ratings. (4) There is new, significantly improved technology for converting syngas to liquid fuels and promising opportunities for further improvements. This is the subject of this report. The purpose of this report is to provide an account and evaluative assessment of advances in the technology for producing liquid energy fuels from syngas and to suggest opportunities for future research deemed promising for practical processes. Much of the improved technology for selective synthesis of desired fuels from syngas has resulted from advances in catalytic chemistry. However, novel process engineering has been particularly important recently, utilizing known catalysts in new configurations to create new catalytic processes. This report is an update of the 1988 study Catalysts for Fuels from Syngas: New Directions for Research (Mills 1988), which is included as Appendix A. Technology for manufacture of syngas is not part of this study. The manufacture of liquid synfuels is capital intensive. Thus, in evaluating advances in fuels technology, focus is on the potential for improved economics, particularly on lowering plant investment costs. A second important criteria is the potential for environmental benefits. The discussion is concerned with two types of hydrocarbon fuels and three types of oxygenate fuels that can be synthesized from syngas. Seven alternative reaction pathways are involved.

13 HYDRO ENERGY

1301 Resources and Availability

23217 (DOE/BP–1909) **Modeling the system: How computers are used in Columbia River planning.** USDOE Bonneville Power Administration, Portland, OR (United States); Corps of Engineers, Portland, OR (United States). North Pacific Div.; Bureau of Reclamation, Boise, ID (United States). Pacific Northwest Region. Oct 1992. 44p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93011649. Source: OSTI; NTIS; GPO Dep.

This publication describes the three computer models Federal agencies and the Northwest Power Pool use regularly to help plan hydro operations in the Columbia River Basin: HYSSR, HYDROSIM, and HYDREG. It is one of a series of booklets written for participants in the System Operation Review (SOR) being conducted jointly by the US Army Corps of Engineers (Corps), the US Bureau of Reclamation (Reclamation), and theBonneville Power Administration (BPA). A list of the other publications appears on the inside front cover. The SOR is the environmental analysis required to consider changes in Columbia River system operations related contract arrangements. Over the next few years, the agencies will develop a new multiple-use operation for the Columbia River. At the time, the Pacific Northwest Coordination Agreement (PNCA) and other contracts related to the Columbia River Treaty between the United States and Canada will be renegotiated and renewed. Many alternative ways of operating individual projects and the river system as a whole will be considered in the SOR. To analyze how these changes would affect the system's ability to meet its multiple-use goals, various operating scenarios will be thoroughly evaluated. The three computer models, HYSSR, HYDROSIM, and HYDREG, will play an important role in this evaluation.

23218 (LA-SUB–93-128) **Remote sensing, image processing and GIS training and technical assistance for Commission Ejecutiva Hidroelectrica Del Rio Lempa (CEL), San Salvador, El Salvador.** Martin, T.C. (Computer Assisted Development, Inc., Fort Collins, CO (United States)). Los Alamos National Lab., NM (United States); Computer Assisted Development, Inc., Fort Collins, CO (United States). 25 Oct 1988. 14p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract W-7405-ENG-36. Order Number DE93010816. Source: OSTI; NTIS; GPO Dep.

The Commission Ejecutiva Hidroelectrica Del Rio Lempa (CEL) has purchased an ERDAS image processing and GIS system which has been installed at CEL facilities in San Salvador. The objective of CEL is to develop the technical capability and expertise for successful use of computer-based image processing and analysis by geographic information system (GIS). Apparently, El Salvador currently does not have this technology and CEL is committed to taking the lead in its development. The objectives of the professional development workshop were to: provide instruction in the background and principles of remote sensing and raster-based GIS; expose the participants to applications of interest; provide hands-on experience using all modules of the ERDAS system; explore with participants and US experts approaches to projects anticipated to use the ERDAS system. The workshop took place at CADI in Fort Collins during October 3–14, 1988. There were five participants from CEL with expertise in the following areas: soil science and watershed management, geology, computer science/

information management, hydrology, civil engineering and statistics.

23219 (VYH-MON–300E) **The observations of the Finnish river ice research project.** Huokuna, M. (ed.). National Board of Waters and Environment, Helsinki (Finland). 1991. 52p. Order Number DE93794805. Source: OSTI; NTIS.

Within the years 1985-1989 a numerical one-dimensional river flow model for winter conditions was developed. The field observations needed for development and calibration of the model have been carried out in four river stretches. In the publication there is a list of the contents of the different files and the description of the format how the data is arranged.

1306 Environmental Aspects

Refer also to citation(s) 23217

23220 (CONF-930870–1) **Spatial simulation of smallmouth bass in streams.** Jager, H.I. (Oak Ridge National Lab., TN (United States)); Schmoyer, D.D.; Sale, M.J.; Van Winkle, W.; DeAngelis, D.L.; Sabo, M.J. Oak Ridge National Lab., TN (United States). [1993]. 11p. Sponsored by USDOE, Washington, DC (United States); Electric Power Research Inst., Palo Alto, CA (United States). DOE Contract AC05-84OR21400. Contract RP2932-2. From Waterpower '93; Nashville, TN (United States); 10-13 Aug 1993. Order Number DE93008578. Source: OSTI; NTIS; INIS; GPO Dep.

The hydropower industry and its regulators are hampered by the inability to predict the relationship between alternative flow regimes and fish population response. We have developed a spatially explicit, individual-based model of populations of small-mouth bass in streams as part of the Compensatory Mechanisms in Fish Populations Program (see Sale and Otto 1991). In the model, the profitability of alternative stream locations varies in response to habitat depth and velocity through changes in the frequency of prey encounters and the metabolic costs experienced by fish. We conducted an evaluation of our hydraulic simulation at the scale of individual stream cells. The potential error in predictions for individual cell velocities suggests that larger-scale model predictions for the representative reach are most appropriate. At this scale, the model appears to produce realistic patterns in the growth and dispersal of young-of-year small-mouth bass. This verification step allows us to proceed with greater confidence in evaluating the original question of how small-mouth bass populations respond to alternative flow regimes.

14 SOLAR ENERGY

23221 (CONF-921276–, pp. 13-16) **Past and present of research and development of solar energy and the problems.** Noguchi, T. (Japan Machinery and Metals Inspection Institute, Tokyo (Japan)). 3 Dec 1992. 305p. (In Japanese). From 1992 Japan Solar Energy Society, Japan Wind Energy Association joint converence; Osaka (Japan); 3-4 Dec 1992. In *1992 JSES (Japan Solar Energy Society)/JWEA (Japan Wind Energy Association) Joint Conference*. Order Number DE93793955. Source: OSTI; NTIS (US Sales Only).

A description is given of the progress of solar energy R and D and evaluation of a relationship between global environmental conservation and solar energy development. It was not until the 1st International Solar Energy Congress held in 1955 that the fundamental modern science/technology was introduced into the field of solar energy utilization. In 1973 the first oil crisis happened, and since 1974 development of petroleum substitution energy has been promoted worldwide and under the governmental leadership, and technology of solar energy utilization has also made a rapid advance. The solar cooling and heating/hot water supply system technology has already passed the stage of practical use and entered into the stage of commercialization, but the cost of the system is still higher than that by fossil fuels. Spread use and promotion of the technology is supported by reduction and exemption of taxes, the subsidy system and the low interest loan system. In the technology field of relatively low temperatures below 200°C such as the solar cooling and heating/hot water supply system, the industrial use solar system, etc., cited as the subjects are cost reduction, development of high-performance equipment/materials, and environmental harmony and architecture design. 3 refs., 1 fig.

1401 Resources and Availability

23222 (CONF-921276–, pp. 279-282) **Simple recording film for measurement of global solar tediation. 4.: Wavelength dependency and fading on slopes.** Sawamoto, H. (Chiba Univ., Chiba (Japan). Remote Sencing and Image Research Center); Yoshimura, T.; Ishikawa, T. 3 Dec 1992. 305p. (In Japanese). From 1992 Japan Solar Energy Society, Japan Wind Energy Association joint converence; Osaka (Japan); 3-4 Dec 1992. In *1992 JSES (Japan Solar Energy Society)/JWEA (Japan Wind Energy Association) Joint Conference*. Order Number DE93793955. Source: OSTI; NTIS (US Sales Only).

The global solar radiation measurement use simple recording film to which the electric power supply is not needed is low in cost and light in weight. Measurements which can be made by that film are simultaneous measurement at numerous spots in the wide area, small area measurement for the botanical leaf and other surfaces, and solar radiation measurement with a long term recording. Dependency on wavelength having been investigated by using several types of sharp-cut filter, their utilization was further studied for the solar radiation measurement on the slope. That film is a film which is based on photography use triacetylcellulose and impregnated with azo pigment (Oil Red-O). The solar radiation is measured by calculating the fading ratio of pigment from the absorptance ratio before and after the exposure at the maximum absorption wavelength of pigment. The fading ratio of Oil Red-O film exponentially decreases against the increasing in solar radiation. The fading coefficient changed with changing in absorptance on a wavelength-by-wavelength basis of pigment so that a dependency was observed on wavelength. However, the different types of filter used for the experiment differ from one another in transmittance of transmitting portion. Therefore, a strict study is needed in conformity with its influence. Solar radiation on the slop was also measured by giving a tilt angle of 15, 30 and 45°, respectively to the horizontal surface. The utilization of global solar radiation measurement use simple recording film was known to be effective for the solar radiation measurement on the slop. 3 refs., 8 figs., 1 tab.

23223 (CONF-921276–, pp. 283-286) **Study on mapping of albedo by using images from meteological satellite.** Otani, K. (Tokyo University of Agriculture and Technology, Tokyo (Japan)); Iizumi, H.; Horigome, T.; Kurokawa, K.; Tsuda, I. 3 Dec 1992. 305p. (In Japanese). From 1992 Japan Solar Energy Society, Japan Wind Energy Association joint converence; Osaka (Japan); 3-4 Dec 1992. In *1992 JSES (Japan Solar Energy Society)/JWEA (Japan Wind Energy Association) Joint Conference*. Order Number DE93793955. Source: OSTI; NTIS (US Sales Only).

Albedo on the ground surface is raised as a problem for the estimation of solar irradiation by the cloud image conveyed from the meteorological satellite. In order to make the estimation with a high accuracy, the cloud image albedo was studied at 18 representative spots in Japan aiming at preparation of albedo map. The albedo observed from the meteorological satellite is classified into three types by pixel, i.e., cloud, atmosphere and ground pixels. The total of atmosphere and ground pixels under the bright sky without cloud is particularly called bright sky albedo. In the histogram method, the bright sky albedo is the minimum of the 16-gradation image element values in histogram. As the histogram is fluctuant by time of image observation, the zenithal time albedo exponent (Rs) which does not depend on the solar position at the time of observation was obtained by zenithally correcting the image data with a least square method to convert the reflectance. The albedo is $R_s \cos Z_{pn}$ where Zpn is an arbitrary zenithal angle. The lowest value of Rs is the bright sky albedo. Outputting from the satellite image could be made of ground albedo which included the reflection in atmosphere under the bright sky. Thus obtained albedo percentages were 3 to 5, 6 to 12 and 15 to 35 on the sea, soil and snow-covered pixels, respectively for the year. The seasonal fluctuation in bright sky albedo is intense in the region having numerous days of snowfall. 5 refs., 3 figs., 2 tabs.

23224 (CONF-921276–, pp. 287-290) **Irradiation estimation by using meteorological satellite images.** Iizumi, H. (Tokyo University of Agriculture and Technology, Tokyo (Japan)); Otani, K.; Horigome, T.; Kurokawa, K.; Tsuda, I. 3 Dec 1992. 305p. (In Japanese). From 1992 Japan Solar Energy Society, Japan Wind Energy Association joint converence; Osaka (Japan); 3-4 Dec 1992. In *1992 JSES (Japan Solar Energy Society)/JWEA (Japan Wind Energy Association) Joint Conference.* Order Number DE93793955. Source: OSTI; NTIS (US Sales Only).

Study was made of daily recording solar irradiation estimation method in which cloud image data obtained from the meteorological satellite are processed with a few regional errors. Selection as a representative was made of 18 spots at which the satellite image could be used. Though in the conventional data recording method, the daily recording was done from the product of irradiation hours multiplied by the mean image element value during the said day, the estimation was newly done by a Simpson's integration setting the sunrise and sunset hours as zero. In the present estimated value recording method, the data obtainment duration were switched from conventional 0900-to-1500 hours to sunrise-to-sunset hours. Estimation accuracy was heightened, which heightening was considerable particularly in the estimated value recording method. Whichever might be the method, three models (the 1st, 2nd and 3rd formulae) of formulation were used for estimating the irradiation. Coefficients were determined by least square method from the data obtained at the 18 spots. Irradiation data done at all 64 spots were similarly processed. Estimation errors were verified upon comparison between both estimated and actually measured values. Among all the estimation formulae, the 1st one which was by the data recording method excelled in regional error as well as estimation on both all spots and spot-by-spot bases, and gave a high fidelity irradiation distribution map which was 0.126 to 0.230 in root-mean-square estimation error. 5 refs., 4 figs., 3 tabs.

1403 Economic, Industrial, and Business Aspects

Refer also to citation(s) 23234

23225 (NEI-DK–1147) **Solar heating systems. Part 1: Quantitative section.** Vilstrup Research A/S, Copenhagen (Denmark). Jan 1993. 128p. (In Danish). ENS-51181-93.0007. Order Number DE93794684. Source: OSTI; NTIS; INIS.

Results of a survey, undertaken by a Danish specialist firm, concerning solar heating systems. The main aim of the analysis was to build up a basis for the choice of a strategy for a campaign for marketing these systems. The survey was founded on telephone interviews with ca. 500 house-owners located throughout the country. Questions posed related to the individuals' current mode of space heating and future wishes in this respect, the amount of acquired information on the subject and the nature of considerations regarding acquisition, the level of information acquired and the choice of information sources, the amount of realistic information on prices, possible subsidies and oil savings related to the supplementary use of solar energy, the name of the relevant commercial supplier and attitudes to a number of aspects connected with the solar heating systems. The results are presented by means of a short explanatory text and a large volume of data. Generally speaking, it is concluded that most people in Denmark are reasonably well-informed on solar heating systems, and that they take environmental considerations seriously. Differences of opinion were related to the fact that some felt that the system itself, placed on roofs, was ugly and could perhaps appear pretentious. Only 5% of the interviewed persons had actually been in contact with an installator, although the majority had a positive attitude towards solar heating systems. (AB).

23226 (NEI-DK–1148) **Solar heating systems: Qualitative investigation of the attitudes of "owners" and "waverers".** Vilstrup Research A/S, Copenhagen (Denmark). 1993. 27p. (In Danish). Contract ENS-51181-93.0007. Order Number DE93794685. Source: OSTI; NTIS; INIS.

This report is based on a previous, related, one which was quantitative in character and relied on 500 telephone interviews with house-owners. The aim of this, following, report was to carry out a more deep-going, qualitative analysis focussed on persons who already own a solar heating system (purchased during 1992) or were/are considering having one installed. Aspects studied were the attitudes, behaviour and plans of these two groups with regard to solar heating systems. Some of the key questions asked concerned general attitudes to energy supply, advantages and disadvantages of using solar heating systems, related decision-making factors, installation problems, positive and negative expectations, evaluation of the information situation, suggestions related to information systems regarding themes etc., dissemination of information, sources of advice and information, economical considerations, satisfaction with the currently-owned system which would lead to the installation of another one in connection with the purchase of a new house. The results of this investigation directed at Danish house-owners are presented and discussed, and proposals for following activities within the marketing situation are given. It is concluded that the basic attitude in both groups strongly supports environmental protection, renewable energy sources and is influenced by considerations of prestige and independence. Constraint factors are confusion about environmental factors, insecurity in relation to the effect of established supplementary energy supply and suspicion with regard to the integrity of information received. (AB).

1405 Solar Energy Conversion

Refer also to citation(s) 23309, 23866, 24117, 24717, 24840

23227 (CONF-921276–) **1992 JSES (Japan Solar Energy Society)/JWEA (Japan Wind Energy Association) Joint Conference.** Japan Solar Energy Society, Tokyo (Japan); Japan Wind Energy Association, Tokyo (Japan). 3 Dec 1992. 305p. (In Japanese). From 1992 Japan Solar Energy Society, Japan Wind Energy Association joint converence; Osaka (Japan); 3-4 Dec 1992. Order Number DE93793955. Source: OSTI; NTIS; Available from Japan Solar Energy Society, Sun Patio 322, 1-5, Takatanobaba 3-chome, Shinjuku-ku, Tokyo, Japan.

The proceedings of the conference include the results of research and development of the photovoltaic power generation system, the wind power generation and biomass. As for the photovoltaic power generation system, reports are made on the following: power generation efficiency of the system, output characteristics of solar cell module, interconnected power system, optical properties of solar cells, solar cell array, development of intermittent flow redox batteries to be used for the photovoltaic power generation system. As to solar radiation utilization, studies on the following are made public: an optical/thermal hybrid heat collector which is designed to obtain light and heat at the same time using a solar cell as a heat collecting board, solar car, a silica gel layer used in a solar thermal utilization direct regenerating type adsorption tank, a solar greenhouse, a solar refrigerating system, solar pond, a solar energy ground thermal storage system, a solar-cell blade wind turbine as a composite system, photovoltaic-thermo composite pannels, solar house, passive solar heating. A small wind turbine generation system for mountanious regions is described. As biomass, production of tall-golden-rod is reported.

23228 (CONF-921276–, pp. 5-6) **Status of new energy development by Kansai Electric Power Company.** Yamaoka, R. (The Kansai Electric Power Co. Inc., Osaka (Japan)). 3 Dec 1992. 305p. (In Japanese). From 1992 Japan Solar Energy Society, Japan Wind Energy Association joint converence; Osaka (Japan); 3-4 Dec 1992. In *1992 JSES (Japan Solar Energy Society)/JWEA (Japan Wind Energy Association) Joint Conference.* Order Number DE93793955. Source: OSTI; NTIS (US Sales Only).

Explanation was made of trials conducted by Kansai Electric Power Company for the photovoltaic, fuel cell, wind power and other power generations. Participating in the Sunshine Project, the Company installed 100 units of a 2kW flat plate type photovoltaic power generation system and 100 domestic use loaders in the Rokko New Energy Center. They have been tested for demonstration since March, 1987. Also within its business province, the Company installed an approx. 1kW system in FY 1991 and 10kW systems at nine different places in FY 1992, and they are being all tested for demonstration. As for the fuel cell system, a 1000kW phosphoric acid fuel cell was tested for demonstration in 1987 and

1988. A 5MW power generation plant presently under construction is scheduled to be tested for demonstration from 1993 through 1996. Both 100kW molten carbonate fuel cell and 25kW solid electrolyte fuel cell are presently under development cooperatively with manufacturers. As for the wind power generation, 5kW propeller type system and 5kW Darrieus type system are being both tested for the demonstration of wind power generation in cold and snow-falling regions. Demonstration research is being also made on the ocean wave energy conversion and solar house.

23229 (CONF-921276–, pp. 7-12) **System interconnection photovoltaic power generation system which assumes the existence of power counterflow for the first time in the actual living house.** Kuwano, Y. (Sanyo Electric Co. Ltd., Osaka (Japan)); Takeoka, A.; Hazaguchi, E.; Waki, M.; Ishida, T.; Makino, Y. 3 Dec 1992. 305p. (In Japanese). From 1992 Japan Solar Energy Society, Japan Wind Energy Association joint converence; Osaka (Japan); 3-4 Dec 1992. In *1992 JSES (Japan Solar Energy Society)/JWEA (Japan Wind Energy Association) Joint Conference*. Order Number DE93793955. Source: OSTI; NTIS (US Sales Only).

Completion for the first time in Japan was made of system in which the power generated by the solar cell panel on the roof of private house is not only consumed for the domestic use in the house but also its surplus is sold to the electric power company. Then, interconnecting operation was started. The general aspect of that system was explained in the present report. No longer requiring the necessity of storing the surplus power in the battery as conventionally done in parts, the method assuming the existence of power counterflow can constitute a rational system in which the power generated in the house during the daytime is normally so excessive as to serve for controlling the daytime peak power by being sent back to the electric power company, while the living during the nighttime is made by the power supplied by the electric power company. That system is composed of solar cell panel, inverter and wattmeter. Its number of solar cell modules is 43 in total for both amorphous silicon and polycrystal silicon types. Its output power is approx. 1.4kW. During one month, the solar cell generated power mounting up to about 100kWh and its about 40% was sold. 3kW photovoltaic power generation system for the domestic use will be widely used at a price of 1 to 2 millions yen per system around 2000. 8 figs., 2 tabs.

23230 (CONF-921276–, pp. 17-22) **Photovoltaic power generation.: Its recent progress and new role in the global environmental problems.** Hamakawa, Y. (Osaka University, Osaka (Japan). Faculty of Engineering Science). 3 Dec 1992. 305p. (In Japanese). From 1992 Japan Solar Energy Society, Japan Wind Energy Association joint converence; Osaka (Japan); 3-4 Dec 1992. In *1992 JSES (Japan Solar Energy Society)/JWEA (Japan Wind Energy Association) Joint Conference*. Order Number DE93793955. Source: OSTI; NTIS (US Sales Only).

The photovoltaic power generation technology is described in terms of its characteristics, results of R and D for high efficiency and cost reduction, economic forecasts including electric power application. Such conversion efficiency is indicated experimentally as 20% for single crystalline silicon, 16% for polycrystalline silicon, and 23% for GaAs. Stack solar cells aiming at low cost and high efficiency are proposed, and research and development using materials in various combinations have been progressing such as a-Si/a-Si, a-SiC/a-Si, a-Si/a-SiGe, a-Si/poly-Si, a-Si/CIS, etc. However, as to crystalline Si and GaAs crystalline solar cells, about 80% of their theoretical critical efficiency have already been achieved. As examples of large-scale integrated power generation, Shikoku Electric Power's 1MW plant in Japan and a 7.2MW plant in the U.S. are now in operation. In these 10 years a module cost has become 280 yen/W, which is thought to be profitable as commercial electric power. 12 refs., 6 figs., 3 tabs.

23231 (CONF-921276–, pp. 23-26) **Measurements and analysis of influence factor and efficiency of PV system. Part 1.: Summary of measurement system and results in summer.** Kozuma, S. (Sanyo Electric Co. Ltd., Osaka (Japan)); Ishihara, O.; Hiyama, T. 3 Dec 1992. 305p. (In Japanese). From 1992 Japan Solar Energy Society, Japan Wind Energy Association joint converence; Osaka (Japan); 3-4 Dec 1992. In *1992 JSES (Japan Solar Energy Society)/JWEA (Japan Wind Energy Association) Joint Conference*. Order Number DE93793955. Source: OSTI; NTIS (US Sales Only).

The paper introduces an outline of a measuring system for the photovoltaic power generation system set on the rooftop of one of the buildings in the campus of Kumamoto University and makes a consideration of the results of measurements in summer. Amorphous silicon (21.0W) and polycrystalline silicon (45.0W) solar cells for electric power use are used here, the use of which is expected for the future in the light of a production cost and power generation efficiency. One solar cell module is set at an azimuth of 0° (exactly south), and the other is set on a solar azimuth automatic tracking turn table. On fine days during the measurements, variations in efficiency of daily module gross generation due to difference in measuring day are larger in polycrystalline solar cells than in amorphous ones, and the efficiency tends to increase as the day passes. Variations in module inside temperature are most affected by an incident solar radiation amount and next by wind velocity. By the multiple regression method including an outside air temperature, it is possible to measure the module inside temperature with satisfactory accuracy. 1 ref., 6 figs., 2 tabs.

23232 (CONF-921276–, pp. 27-30) **Characteristics of PV module output considered the environmental factors.** Kobayashi, M. (Science University of Tokyo, Tokyo (Japan)); Tani, T. 3 Dec 1992. 305p. (In Japanese). From 1992 Japan Solar Energy Society, Japan Wind Energy Association joint converence; Osaka (Japan); 3-4 Dec 1992. In *1992 JSES (Japan Solar Energy Society)/JWEA (Japan Wind Energy Association) Joint Conference*. Order Number DE93793955. Source: OSTI; NTIS (US Sales Only).

For the optimal design of the photovoltaic power generation system, solar cell modules are modeled to analyze a relationship between environmental factors and cell temperature of the solar cell. With the measuring data, validity of the analysis is shown. Next, a relationship between seasonal variations of spectral distribution of solar radiation and output of the solar cell module is clarified and considered. Further, annual power generation is calculated using the above-mentioned analytical results. The analytical and measuring results show that there is a linear relationship between intensity of solar radiation and the cell temperature, and with regard to wind velocity, a marked cooling effect of the module is observed at wind velocity below 3m/s. Using K, a value corresponding to conversion efficiency of the solar cell module, obtained is monthly conversion efficiency and K value. As a result, a correlation clearly exists between the both as to amorphous solar cell modules and the conversion efficiency fluctuates 25% at highest. As to polycrystalline solar cell modules, the values which are relatively near to the measuring values are obtained by applying the cell temperature. 6 refs., 8 figs., 3 tabs.

23233 (CONF-921276–, pp. 31-34) **Photovoltaic generating system of EMH (Energy Management House).** Rikihisa, K. (Kyushu Electric Power Co. Inc., Fukuoka (Japan)); Fujii, K.; Yamasaki, K.; Hachimure, M.; Fukuda, T. 3 Dec 1992. 305p. (In Japanese). From 1992 Japan Solar Energy Society, Japan Wind Energy Association joint converence; Osaka (Japan); 3-4 Dec 1992. In *1992 JSES (Japan Solar Energy Society)/JWEA (Japan Wind Energy Association) Joint Conference*. Order Number DE93793955. Source: OSTI; NTIS (US Sales Only).

An EMH is a wide-spread type energy saving house aiming at both energy conservation and amenity of the residential environment. This paper reports a status of power generation of the photovoltaic generation system installed in the EMH. The output of solar cells is divided into two systems: one system connects 204Wp from the cells set on the south side to a ventilating fan as they are in direct current. The other connects the remaining 1836Wp to a heat pump air conditioning and water heater by controlling the maximum output and converting them to an alternating current with invertor. A family (a couple and two children) lived as monitors in an EMH for a week. As a result, the family's mean electric power consumption per day was approximately 44kW (including the electric water heater). In this case, it is found that in the system of a scale of the EMH, about 10% of the electric power consumption in summer can be provided by solar cells. At the same time there appeared the problem that the cell temperature rose to 66°C

on the days with high solar radiation, which caused reduction in conversion efficiency of nearly 2%. 1 ref., 11 figs., 1 tab.

23234 (CONF-921276–, pp. 35-38) **Reasonable method for the use of P.V. systems from the international viewpoint.** Anno, T. 3 Dec 1992. 305p. (In Japanese). From 1992 Japan Solar Energy Society, Japan Wind Energy Association joint converence; Osaka (Japan); 3-4 Dec 1992. In *1992 JSES (Japan Solar Energy Society)/JWEA (Japan Wind Energy Association) Joint Conference.* Order Number DE93793955. Source: OSTI; NTIS (US Sales Only).

To widely spread the photovoltaic power generation, studied is a policy for implementing measures for price reduction by a mass production effect. Basically, an implementing plan for wide spread is worked out, and reducing prices to be brought by increasing production under the plan are calculated. Then, the annual amount of money required to carry out the plan is calculated. As a long-term plan for the wide spread, in a ten-year plan, a base for a 3kW system is established by 100 each a year. This pace continues for ten years. Annual cost is several hundred million yen, and the price of a solar cell which is presently 460-585 yen/W will be 60-230 yen/W in 10 years. Further, for 40 years from the 11th year to the 50th year of the long-term plan, equipment output will reach 200 million kW and the price of a solar cell will be 14-120 yen/W (Program D). Assuming that annual domestic electric power consumption is 650 billion kW and will be 1.6 times 40 years later, Project D can provide 16% of the consumption. As a development plan, energy conservation by a DC method should be attempted. It is necessary to make good use of the characteristic that the photovoltaic power generation is fit for peak cut power generating. 6 refs., 1 tab.

23235 (CONF-921276–, pp. 39-42) **Development of compact protective control unit for grid connected small residential systems.** Takigawa, K. (Central Research Institute of Electric Power Industry, Tokyo (Japan)); Kobayashi, H. 3 Dec 1992. 305p. (In Japanese). From 1992 Japan Solar Energy Society, Japan Wind Energy Association joint converence; Osaka (Japan); 3-4 Dec 1992. In *1992 JSES (Japan Solar Energy Society)/JWEA (Japan Wind Energy Association) Joint Conference.* Order Number DE93793955. Source: OSTI; NTIS (US Sales Only).

Together with showing that it is comparatively profitable to outfit a compact protective control unit for the grid connected small residential system, the present paper explained the experimental production result of a protective control unit for the grid connection assuming the existence of power counterflow. Basic functions required for protecting the grid connection are function of interrupting the accident current by detecting the excess current, earthing current, etc. and stopping/paralleling the consumer's unit off, function of stopping/paralleling the consumer's system off by detecting the anomaly in voltage, frequency, etc., function of stopping/paralleling the consumer's system off by detecting the reverse charging operation, etc., and function of protecting the consumer's system from the lightning surge, etc. By taking all the above functions into consideration, a compact protective control unit to be outfitted for the grid connection was experimentally produced for the use of small residential system assuming the existence of power counterflow. That unit is endowed with functions of generally protecting the system, preventing the reverse charging, automatically diagnosing the trouble and displaying the service. Its basic performance has been so far confirmed. The method applied to the present unit for preventing the reverse charging results from the research entrusted by the NEDO. 2 figs., 3 tabs.

23236 (CONF-921276–, pp. 43-46) **Demonstration research on islanding preventing methods for small scale PV systems.** Kobayashi, H. (Central Research Institute of Electric Power Industry, Tokyo (Japan)); Kitamura, A. 3 Dec 1992. 305p. (In Japanese). From 1992 Japan Solar Energy Society, Japan Wind Energy Association joint converence; Osaka (Japan); 3-4 Dec 1992. In *1992 JSES (Japan Solar Energy Society)/JWEA (Japan Wind Energy Association) Joint Conference.* Order Number DE93793955. Source: OSTI; NTIS (US Sales Only).

Demonstrative evaluation is made on methods for preventing reverse charging operation of a small scale photovoltaic power system of an interconnected power system type with an output of about several kW. The reverse charging operation method is divided into a passive one and an active one. The paper evaluates a frequency bias method and an effective power fluctuation method among the active method, through demonstration tests conducted at Rokko Island test facilities. For the active method, the condition required is that in addition to stopping the PV system rapidly and surely at reverse charging operation, frequency, fluctuation values of output power or fluctuation setting values should not affect voltage fluctuation and stability of a distribution line more than a necessity and a minimum, at a steady time. The frequency bias method is for a current-control inverter use and the main body is a phase lock oscillator which is given frequency bias. This oscillator is serially connected with the interconnected point voltage signal inputting the inverter. In the effective power fluctuation method, the inverter is equipped with effective power fluctuating function. Validity of both methods is verified. 2 refs., 5 figs., 1 tab.

23237 (CONF-921276–, pp. 47-50) **Performance test and evaluation of small scale PCSs and batteries for PV application.** Takigawa, K. (Central Research Institute of Electric Power Industry, Tokyo (Japan)); Kobayashi, H. 3 Dec 1992. 305p. (In Japanese). From 1992 Japan Solar Energy Society, Japan Wind Energy Association joint converence; Osaka (Japan); 3-4 Dec 1992. In *1992 JSES (Japan Solar Energy Society)/JWEA (Japan Wind Energy Association) Joint Conference.* Order Number DE93793955. Source: OSTI; NTIS (US Sales Only).

As entrusted by the NEDO, the present research was made on the tested performance of small scale power conversion system (PCS) for the photovoltaic (PV) application. Battery-testing facilities comprise three systems. Each of those systems is composed of battery-charging/discharging control circuit, individual monitory control circuit and individual testing bed. Charging/discharging can be tested up to 12V and 500A in voltage and intensity of current, respectively by the facilities. Besides different short term basic characteristic tests, conducted were over-charge/discharge withstanding test, PSOC cycle test and acceleration life test. The PCS test facilities are composed of power source unit to simulate the solar cell array, commercial power source unit, wiring unit and loading unit which are all for the simulation use, and trouble-generating unit. The PCS's performance can be tested for both independent power source use and system interconnection use up to 10kW in rated output. The lead battery developed by the NEDO for the PV application is sufficiently promising with a life of about ten years. The small scale PCS of domestic product installed in the Rokko Island bears comparison with that of foreign product in test result. 5 figs., 4 tabs.

23238 (CONF-921276–, pp. 51-54) **Optical properties of solar cells using the static concentrator.** Yoshioka, K. (Tokyo University of Agriculture and Technology, Tokyo (Japan)); Liew, L.; Suzuki, A.; Kobayashi, M.; Saito, T.; Kobayashi, S. 3 Dec 1992. 305p. (In Japanese). From 1992 Japan Solar Energy Society, Japan Wind Energy Association joint converence; Osaka (Japan); 3-4 Dec 1992. In *1992 JSES (Japan Solar Energy Society)/JWEA (Japan Wind Energy Association) Joint Conference.* Order Number DE93793955. Source: OSTI; NTIS (US Sales Only).

Solar cells were experimentally manufactured with the use of static concentrator and their properties were measured as condensing module. Using acrylic resin, the condensing lenses were made able to condense the incidence system within 3O° without following it. The used solar cell was of monocrystalline silicon type and its surface area was 4cm^2. When the angle of sunlight incidence was 0 to 20°, the short circuit current with the condensing lenses was known to be about 1.5 times as strong as that without them. When the above angle was equally 0 to 20°, there was no change in I-V properties. However, when that angle became larger than 25°, the above current with the above lenses started to weaken, and when it became 40°, the weakening in it was found much larger than that without them. The conversion efficiency with them is always lower than that without them. It is judged attributable to the light reflection on the lens surface and light absorption by the lens material. The optical efficiency was kept as stable as 1.65 in value. It was confirmed that the condensing lenses as a static concentrator can be designed to aim at the condensation of sunlight. 2 refs., 6 figs.

23239 (CONF-921276–, pp. 55-58) **New design of non-imaging refractive concentrator and its optical characteristics.** Kobayashi, M. (Tokyo University of Agriculture and Technology,

Tokyo (Japan). Faculty of Technology); Suzuki, A.; Kobayashi, S. 3 Dec 1992. 305p. (In Japanese). From 1992 Japan Solar Energy Society, Japan Wind Energy Association joint converence; Osaka (Japan); 3-4 Dec 1992. In *1992 JSES (Japan Solar Energy Society)/JWEA (Japan Wind Energy Association) Joint Conference*. Order Number DE93793955. Source: OSTI; NTIS (US Sales Only).

A low magnification concentrator was designed to be statically used as a premise for the solar cell module in order to lower the cost for the solar cells. Then, its optical characteristics were investigated. The concentration was made firstly for the reason that the concentration by a low cost optical system having a wide opening area can narrow the required area of high cost photovoltaic converter. The second reason was that the strengthening in intensity of radiant ray incident in the photovoltaic converter generally heightens the efficiency in the conversion process or grade of the conversion energy. Lenses were designed under the condition that the light passage length was constant. Those lenses are of two-dimensional concentration having a focus which is linear. Materially made of acrylic resin, they were designed to be 1.49 in refractive index against 900nm which is the peak value of sensitivity of crystalline silicon solar cell. As a result of calculating the lens characteristics by a ray tracing method, it was confirmed that all light within the permissible angle range of incidence can be concentrated into the concentration range. 3 refs., 3 figs.

23240 (CONF-921276–, pp. 59-62) **Steady and unsteady characteristics of photovoltaic array exposed to natural environment.** Nawata, Y. (Yatsushiro National College of Technology, Kumamoto (Japan)). 3 Dec 1992. 305p. (In Japanese). From 1992 Japan Solar Energy Society, Japan Wind Energy Association joint converence; Osaka (Japan); 3-4 Dec 1992. In *1992 JSES (Japan Solar Energy Society)/JWEA (Japan Wind Energy Association) Joint Conference*. Order Number DE93793955. Source: OSTI; NTIS (US Sales Only).

The characteristics of power generated by the solar cells were obtained under the condition of natural environment from a long term measurement through experiment on the system interconnection type photovoltaic power generation system. Dependency of solar cell temperature on the quantity of solar radiation, atmospheric temperature and wind velocity was elucidated through experiment together with showing a method to analytically obtain the temperature of solar cells from their thermal balance. Their unsteady output characteristics were also studied in case of taking their thermal capacity into consideration. Totally $24 \times 0.44 m^2$ modules were used to form polycrystalline silicon type solar cells. Even against the same quantity of solar radiation of $600 W/m^2$, the solar cell conversion efficiency is 14% and 9% at 30 centigrade and 60 centigrade, respectively in cell temperature with a considerable difference between both. In order to calculate the power generated by the array, a polyregression formula was obtained through multivariate analysis by expressing the solar cell temperature as a function of six variables, i.e., quantity of solar radiation, atmospheric temperature, wind velocity and their respective products. In case of calculating the output of solar cells during a certain term, a sufficient accuracy can be obtained even by presuming a steady state with neglecting their thermal capacity. 4 refs., 9 figs., 1 tab.

23241 (CONF-921276–, pp. 63-66) **Analysis on performance of PV-array I-V curve tracer by the capacitive load method.** Kawai, H. (Tokyo University of Agriculture and Technology, Tokyo (Japan)); Horigome, T.; Kurokawa, K. 3 Dec 1992. 305p. (In Japanese). From 1992 Japan Solar Energy Society, Japan Wind Energy Association joint converence; Osaka (Japan); 3-4 Dec 1992. In *1992 JSES (Japan Solar Energy Society)/JWEA (Japan Wind Energy Association) Joint Conference*. Order Number DE93793955. Source: OSTI; NTIS (US Sales Only).

Relation was numerically analyzed between the sampling time interval and calculating error in the I-V curve measurement unit by capacitive load method for measuring the output characteristics of photovoltaic power generation. The capacitive load method excels the conventional one in large capacity measurement. However, the curve to be measured changes with external factors so that careful measures must be taken. The short circuit current, release voltage and highest output operating point (P) all of which are basic parmeters for the output characteristics were approximatively calculated from the measured curve. Though the holding current and lowering in forward voltage of thyristor must be compensated, the external series resistance loss is judged normally negligible from the standpoint of error analysis. The sampling time interval considerably influences the calculative determination of P. It was made clear that the application of Lagrange's three-dimensional approximation excels in approximate calculation which can control the necessary capacity of condenser. Consequently, it became possible to determine the capacity. 3 refs., 9 figs., 1 tab.

23242 (CONF-921276–, pp. 67-70) **Maximum-power-point control of photovoltaic at high frequency switching.** Tokuda, K. (Doshisha University, Kyoto (Japan)); Harada, K.; Ishihara, Y.; Todaka, T. 3 Dec 1992. 305p. (In Japanese). From 1992 Japan Solar Energy Society, Japan Wind Energy Association joint converence; Osaka (Japan); 3-4 Dec 1992. In *1992 JSES (Japan Solar Energy Society)/JWEA (Japan Wind Energy Association) Joint Conference*. Order Number DE93793955. Source: OSTI; NTIS (US Sales Only).

In order to prevent hysteresis in the maximum-power-point control for the photovoltaic, study was made of a method in which the maximum-power-point is detected/controlled by controlling the fluctuation in both voltage and current of photovoltaic within the switching period, and then, fluctuating both of them by duty ratio at a comparatively low frequency. When they are fluctuated within the vicinity of maximum-power-point at a low frequency, the duty ratio is controlled by setting an appropriate offset on a period-by-period basis against the fluctuation in duty ratio. Thus, the maximum-point can be detected as the photovoltaic power characteristics are stabilized without plotting hysteresis even at a high frequency switching. A CuK converter was used as a DC-to-DC converter. As a result, it could be confirmed from the observed waveform and its Lissajous's figure that the fluctuation in photovoltaic power is small and that the power characteristics do not plot hysteresis. Both maximum power and voltage which were theoretically obtained from the quantity of solar radiation and atmospheric temperature agreed well with both of them which were actually measured. 8 refs., 6 figs.

23243 (CONF-921276–, pp. 71-74) **Control method against the long period deterioration of the solar cell.** Itsumi, J. (Kumamoto Institute of Technology, Kumamoto (Japan)). 3 Dec 1992. 305p. (In Japanese). From 1992 Japan Solar Energy Society, Japan Wind Energy Association joint converence; Osaka (Japan); 3-4 Dec 1992. In *1992 JSES (Japan Solar Energy Society)/JWEA (Japan Wind Energy Association) Joint Conference*. Order Number DE93793955. Source: OSTI; NTIS (US Sales Only).

In order to control the initial deterioration in amorphous solar cell, a method to control the long period deterioration was studied based on the effect of heat treatment directly from the exterior. One time of treatment of the deterioration by annealing at temperatures of 100 to 120 centigrade by a condensing/heating unit was found effective to some extent for stopping the progress of optical deterioration. However, the recovery effect is weakened by long-time optical irradiation. Therefore, effective control of the deterioration is repeated annealing, for which the annealing period (τ) is an important parameter. As a result of annealing directly from the exterior the solar cell which has been exposed to the optical irradiation for five years, the generated power output which had been lowered down to 50% could be recovered up to 72%. The annealing, if made every constant period (τ), could give a possibility of heightening the recovery ratio of solar cell and lengthening the durability of a deterioration control effect. 9 refs., 2 figs., 2 tabs.

23244 (CONF-921276–, pp. 75-78) **Evaluation of photovoltaic modules considered spectral solar radiation.** Hirata, Y. (Science University of Tokyo, Tokyo (Japan)); Tani, T. 3 Dec 1992. 305p. (In Japanese). From 1992 Japan Solar Energy Society, Japan Wind Energy Association joint converence; Osaka (Japan); 3-4 Dec 1992. In *1992 JSES (Japan Solar Energy Society)/JWEA (Japan Wind Energy Association) Joint Conference*. Order Number DE93793955. Source: OSTI; NTIS (US Sales Only).

The paper discusses a method to obtain annual output of solar cell modules (SM) using measuring data on intensity of solar radiation including annual spectral distribution of solar radiation and basic SM characteristics. A spectral method is proposed to obtain output of various SM from intensity of solar radiation measured by

spectropyrheliometer and basic characteristics of polycrystalline and amorphous silicon SM such as spectral response characteristic which are measured by solar simulator. A comparison is made between results of calculation by this method and results of measurement of solar cell modules installed on the rooftop of the campus building of Science University of Tokyo. As a result, solar spectra are found to have an effect on the output of polycrystalline silicon and amorphous silicon solar cell modules. In comparison of the output integrating amount with the conventional method, there is seen little difference in polycrystalline silicon SM. In amorphous silicon SM, a change of monthly output in the spectral method is close to the measuring values and is found to be affected strongly by solar spectra. 5 refs., 6 figs., 3 tabs.

23245 (CONF-921276–, pp. 79-82) **Influence of I-V characteristics of PV cell on stand alone PV power systems.** Tsuda, I. (Electrotechnical Laboratory, Tsukuba (Japan)); Kurokawa, K. 3 Dec 1992. 305p. (In Japanese). From 1992 Japan Solar Energy Society, Japan Wind Energy Association joint converence; Osaka (Japan); 3-4 Dec 1992. In *1992 JSES (Japan Solar Energy Society)/JWEA (Japan Wind Energy Association) Joint Conference.* Order Number DE93793955. Source: OSTI; NTIS (US Sales Only).

In the stand alone photovoltaic (PV) power generation system, it is judged probable that the optimized operating point of PV cell differs from the operating point of PV power generation system including the actual lead acid battery. To elucidate its influence, cases which differed from one another in I-V characteristics of the used PV cell were compared by simulation all through the year. As the system is to be fed with AC load, DC is converted into AC by an inverter for the feeding. The lead acid battery is connected with the PV cell array in a form excluding the DC-to-DC converter. The fluctuation in operating voltage of system is linear against that in optimized operating voltage of PV cell with a gradient of about 0.5. The optimized operating voltage of system happens to be higher than that of PV cell due to self-discharging of the lead acid battery. In the region where the ratio of voltage at the optimized operating point is higher than 0.6 to the release voltage, the larger that ratio is, the larger the system scale is known to be. 2 refs., 9 figs., 2 tabs.

23246 (CONF-921276–, pp. 83-86) **Development of intermittent flow redox battery. Part 2.** Tsuda, I. (Electrotechnical Laboratory, Tsukuba (Japan)); Kurokawa, K.; Nozaki, K. 3 Dec 1992. 305p. (In Japanese). From 1992 Japan Solar Energy Society, Japan Wind Energy Association joint converence; Osaka (Japan); 3-4 Dec 1992. In *1992 JSES (Japan Solar Energy Society)/JWEA (Japan Wind Energy Association) Joint Conference.* Order Number DE93793955. Source: OSTI; NTIS (US Sales Only).

A redox flow battery which is promising as a battery to be used for the photovoltaic power generation system was operated in a practical operation mode by increasing the number of cells up to 46 and making them four-stack structured. The operation result was reported in the present paper. Cells which constitute the same stack are fed in parallel with electrolyte of redox flow battery. Because dispersion does consequently not occur in charged state among the cells, the terminal voltage of battery can be changed by switching the output use terminal. In the operation with flow stoppage, the current efficiency can be designed to be considerably heightened. At the time of weak charging/discharging current, the intermittent flow operation is higher in performance than the continuous flow operation. However with strengthening in the above current, it lowers and approaches the continuous flow operation in performance. Even if the cell voltage happened to be anomalous in value, it did not lower in performance with a result which was optimized by operating the pump for 60 seconds. From the foregoing, the lowering in performance of both continuous and intermittent flow operations was known to be attributable to the piping loss around the stack. 3 refs., 8 figs., 3 tabs.

23247 (CONF-921276–, pp. 87-90) **Characteristics of wave shifting device.: Effect of the diffused reflection face.** Takahashi, K. (Science University of Tokyo, Tokyo (Japan)); Tani, T.; Saito, S.; Nakaide, T. 3 Dec 1992. 305p. (In Japanese). From 1992 Japan Solar Energy Society, Japan Wind Energy Association joint converence; Osaka (Japan); 3-4 Dec 1992. In *1992 JSES (Japan Solar Energy Society)/JWEA (Japan Wind Energy Association) Joint Conference.* Order Number DE93793955. Source: OSTI; NTIS (US Sales Only).

For a possibility of high efficiency photosynthesis by the plants, research is being made by taking the absorption characteristics into consideration on a wavelength-by-wavelength basis and thus shifting the wavelength. In the present study which was within a series of the above research, it was designed as a wavelength shifting device to use an acrylic resin-doped fluorescent dye concentrator which is called LSC (luminescent solar concentrator) and treat the LSC surface by a diffused reflection surface treatment in order to intensify the light emission. The above device was then proved effective. As the reflective index of acrylic resin used for the experiment is 1.5, the critical angle of incidence is $\sin^{-1}(1/1.5) = 41.8°$. As a result of simulation, the intensity of light emission from the treated surface upon diffused reflection surface treatment is 1.62 times as strong as that before the treatment, which means a considerable strengthening in it through the treatment. In the experiment, the strengthening in it is highest when the surface upon which the light is incident (i.e., light-receiving surface) is made a diffused reflection surface by treatment with sandpaper #80. At that time, the strengthening ratio was about 26% so that the diffused reflection surface treatment was known to be considerably effective. 7 refs., 6 figs., 1 tab.

23248 (CONF-921276–, pp. 91-94) **Concentration ratio and collection efficiency of a luminescent solar concentrator.** Sakuta, K. (Electrotechnical Laboratory, Tsukuba (Japan)); Sawata, S.; Tanimoto, M. 3 Dec 1992. 305p. (In Japanese). From 1992 Japan Solar Energy Society, Japan Wind Energy Association joint converence; Osaka (Japan); 3-4 Dec 1992. In *1992 JSES (Japan Solar Energy Society)/JWEA (Japan Wind Energy Association) Joint Conference.* Order Number DE93793955. Source: OSTI; NTIS (US Sales Only).

Research is being made on the luminescent solar concentrator (LSC) which utilizes the absorption/reradiation by the fluorescent body and light confining by total reflection between the parallel flat plates. In the present study, relation was elucidated between the geometric concentration ratio and collection efficiency of LSC through experiment by a prototype LSC and calculation by a Monte Carlo simulation. Used is a perylene pigment-doped acrylic resin plate which was cut to 30, 100, 300 and 1000mm square, and polished on the surface edge. For the experimental prototype LSC, the lowering in collection efficiency against the heightening in geometric concentration ratio was known not to be so large in the region where the absorption by the base material was negligible. The result of Monte Carlo simulation agreed almost with the experimental result by the prototype so that the concentration process by the present LSC was firmly known to be correctly described. 5 refs., 8 figs.

23249 (CONF-921276–, pp. 95-98) **High efficiency crystalline silicon solar cells.** Nanmori, T. (Sharp Corp., Osaka (Japan)); Okamoto, S.; Shibuya, N.; Nunoi, T.; Sawai, H. 3 Dec 1992. 305p. (In Japanese). From 1992 Japan Solar Energy Society, Japan Wind Energy Association joint converence; Osaka (Japan); 3-4 Dec 1992. In *1992 JSES (Japan Solar Energy Society)/JWEA (Japan Wind Energy Association) Joint Conference.* Order Number DE93793955. Source: OSTI; NTIS (US Sales Only).

In order to design the heightening in efficiency of crystalline silicon solar cell, study was made, as reported in the present paper, of light-receiving front surface electrode configuration and rear surface reflection effect by using monocrystalline base plate and sizing a cell from it to a practical level of 5cm square. Result was also reported of experimental cell production. As a result of calculating the pitch, bottom breadth and thickness of subgrid optimized for the light-receiving front surface electrode configuration, it was made clear in case of 1mm pitch that the thickening in subgrid rather than the enlarging in bottom breadth largely contributes to the heightening in cell characteristics. In the study of rear surface reflection effect, it was made clear that the long wavelength sensitivity of cell is heightened together with improvement in light confining effect by forming an electrode made of silver, high reflection material on the P^+ layer surface from which aluminum-pasted alloy layer is removed. Upon experimental cell production based on

the foregoing result, the 5cm square cell of practical size gave a conversion efficiency of 20.4%. 6 figs.

23250 (CONF-921276–, pp. 99-102) **Simulation calculation of running mode on "solar car race Suzuka '92" and the results.** Kanayama, K. (Kitami Institute of Technology, Hokkaido (Japan)); Baba, H.; Endo, N.; Tezuka, H.; Koyano, T. 3 Dec 1992. 305p. (In Japanese). From 1992 Japan Solar Energy Society, Japan Wind Energy Association joint converence; Osaka (Japan); 3-4 Dec 1992. In *1992 JSES (Japan Solar Energy Society)/JWEA (Japan Wind Energy Association) Joint Conference.* Order Number DE93793955. Source: OSTI; NTIS (US Sales Only).

Both solar cars SEV-1 and Blue Eagle which were developed by Kitami Institute of Technology and Kyocera Corp. participated in the "Solar Car Race Suzuka '92" held on 8 and 9 August, 1992. Prior to proceeding with the race, a traveling guidance was prepared through running mode design by simulation in advance from the course condition, radiant quantity of sunlight and principal particulars of car. Correlation was investigated between the required time per round and traveling speed in the actual race. For calculation by simulation, the course was divided into 53 sections, in each of which the slope, direction and time were obtained. Then, the calculation was made of solar cell power output, speed, traveling distance, motor shaft torque, feeding energy and total efficiency of the solar car at the different points. Finally, the required time, reserved energy in batteries and dependency on solar cells were calculated, which gave the optimized result in running mode. The actual traveling condition in the race could be almost as per the above calculation by simulation. 4 refs., 6 figs., 2 tabs.

23251 (CONF-921276–, pp. 115-118) **Studies of solar air collectors with solar cell modules as the cover.** Ito, S. (Kanagawa Institute of Technology, Kanagawa (Japan)); Miura, M. 30 Dec 1992. 305p. (In Japanese). From 1992 Japan Solar Energy Society, Japan Wind Energy Association joint converence; Osaka (Japan); 3-4 Dec 1992. In *1992 JSES (Japan Solar Energy Society)/JWEA (Japan Wind Energy Association) Joint Conference.* Order Number DE93793955. Source: OSTI; NTIS (US Sales Only).

Both experimental and theoretical studies were made of characteristics of a thermal collector which used partially sunlight-transparent photovoltaic cell modules as a surface cover. The photovoltaic cell modules having an opening area ratio of 50% were used as a collector plate as well as surface cover. In experiment, air was made to flow in a space between the collector plate and bottom collector plate for forming an solar air collector which collected the solar heat. Then, obtainment was made of both its electric power generation and solar air collection characteristics. In the theoretical study, influence was investigated of thermal medium temperature, wind speed and opening air ratio on the thermal collection efficiency. Though having an area of 0.40m^2, one solar cell module outputs comparatively low power of about 5W at 600W/m^2 in radiant quantity of sunlight. That power was weakened by about 18% after elapsing of one year. When the intensity of sunlight radiation was comparatively strong, a thermal collection efficiency attained to about 38%. With heightening in sunlight-transparency of surface cover, that efficiency heightens due to increasing in thermal quantity received on the bottom collector plate. It was also theoretically shown that influence of wind speed is large on that efficiency. 3 refs., 8 figs.

23252 (CONF-921276–, pp. 103-106) **Make and appraise the performance of SEG hybrid car.** Hase, J. (Tokyo University of Agriculture and Technology, Tokyo (Japan)); Moriya, T.; Horigome, T. 3 Dec 1992. 305p. (In Japanese). From 1992 Japan Solar Energy Society, Japan Wind Energy Association joint converence; Osaka (Japan); 3-4 Dec 1992. In *1992 JSES (Japan Solar Energy Society)/JWEA (Japan Wind Energy Association) Joint Conference.* Order Number DE93793955. Source: OSTI; NTIS (US Sales Only).

Designed by simultaneously adopting the merit of electric cars and that of gasoline cars which are very widely used at present, hybrid car was developed for the possibility of being practically used as a next generation car. As is the case with ordinary passenger cars, the gasoline engine arranged in the front body of prototype hybrid car drives the front wheels, while the electric motor and batteries done in its rear body do the rear wheels. The solar cells (about 200Wp) fitted on the car body can feed about 30% of the required energy to be consumed. In case of ten-mode traveling, the car gave a sufficient practicability even by using a comparatively low output motor of 5.5kW. Switching could be made without shock during the test on starting up the gasoline engine at 20km/h in speed and disconnecting the electric motor from the driving system. As a result of both actual measurement and simulation, 20 to 30% of the required power to be used were known to be feedable by the solar cells mounted on board under a bright sky. 3 refs., 10 figs.

23253 (CONF-921276–, pp. 107-110) **Development of excellent practically usable solar electric vehicle.** Fujinaka, M. (Tokyo Denki University, Tokyo (Japan)). 3 Dec 1992. 305p. (In Japanese). From 1992 Japan Solar Energy Society, Japan Wind Energy Association joint converence; Osaka (Japan); 3-4 Dec 1992. In *1992 JSES (Japan Solar Energy Society)/JWEA (Japan Wind Energy Association) Joint Conference.* Order Number DE93793955. Source: OSTI; NTIS (US Sales Only).

Electric vehicle (EV) was designed by development through the lightening in weight, improvement in discharging characteristics by recomposition of batteries and effective utilization of photovoltaic cells mounted on board. 960kg were lightened to 830kg by removing unnecessary parts as many as possible from a CR-X, Honda-make gasoline car. The necessary energy was about 10% saved for the traveling by rolling resistance energy. The rated capacity was about 5% improved by designing a recomposition of batteries to lighten the load on them against the strong discharging when the EV started up. About 8% of the traveling energy were made self-feedable on the assumption that energy of 1.2kwh was daily obtainable under a bright sky by connecting 200W output from the high performance monocrystalline silicon solar cells to the main batteries and 40W output from the flexible amorphous silicon solar cells to the auxiliary batteries. The traveling distance by one time of changing attained 60km in 1989 and 1990. The EV was optimized in performance with a two-speed gear motor fed with energy from the batteries which formed two series of 48V in parallel. 9 refs., 10 figs.

23254 (CONF-921276–, pp. 119-122) **Simulation study on energy consumption of single family house with solar heating and PV systems.** Udagawa, M. (Kogakuin University, Tokyo (Japan)); Minami, S. 3 Dec 1992. 305p. (In Japanese). From 1992 Japan Solar Energy Society, Japan Wind Energy Association joint converence; Osaka (Japan); 3-4 Dec 1992. In *1992 JSES (Japan Solar Energy Society)/JWEA (Japan Wind Energy Association) Joint Conference.* Order Number DE93793955. Source: OSTI; NTIS (US Sales Only).

Assuming that a solar domestic hot water (DHW) heating system together with photovoltaic (PV) cells was installed in a single family house, the performance of both solar heating and PV systems in the house was predicted by a simulation conducted for the year. Located in Tokyo, the model house was a wooden house having a total floor area of 126m^2. A heat collector and PV cells were installed on the roof facing south with a tilt angle of 60° and 35°, respectively. The solar heating system is divided into solar DHW supply system and DHW floor heating system. The array of PV cells was formed by a connection in three series parallel respectively having nine modules, each of which comprised 36 cells. As a result of simulation, the solar DHW floor/air heating system excelled in comfortability however without giving a considerable lowering in power required for the air heating. The solar DHW supply system together with PV cells had an energy saving effect for the year on the house by saving approx. 53% of the required energy for the house which was without installation of that system. 7 refs., 9 figs., 3 tabs.

23255 (CONF-921276–, pp. 155-158) **Cold storage system operated only by renewable energy.: Development of "solar J box".** Ouchi, K. (Mitsui O.S.K. Line, Ltd., Osaka (Japan)); Imamura, A. 3 Dec 1992. 305p. (In Japanese). From 1992 Japan Solar Energy Society, Japan Wind Energy Association joint converence; Osaka (Japan); 3-4 Dec 1992. In *1992 JSES (Japan Solar Energy Society)/JWEA (Japan Wind Energy Association) Joint Conference.* Order Number DE93793955. Source: OSTI; NTIS (US Sales Only).

Research and development are made on a new type of cold storage system (Solar J. System) which is gentle to the environment using ice made from cold winter air in cold districts as a cold heat source and an electric fan powered by the photovoltaic power generation for cold air circulation. The Solar J. Box is a system in which the two ISO type floating containers are thermally insulated on their inside and outside surfaces, and one container stores approximately 10 tons of low-temperature stores of farm products, etc. as a storage house and the other houses an ice container such as a drum as an ice box. Both containers are connected by pipes. In the system, by circulating air with a ventilating fan powered by solar cells and electric batteries, heat exchange is made between ice and stores, and the stores are kept at low temperatures of about 0-5°C. As for ice, cold winter air below the freezing point in the cold district is let in to the ice box and is naturally convected for the heat exchange, and the water of the ice box is changed to ice. The desired performance of the system is verified through the long-term (6 months) test conducted on the storage of potato. 8 figs.

23256 (CONF-921276–, pp. 207-210) **Analysis on solar cogeneration system with thermoelectric devices.** Tashiro, T. (Tokyo University of Agriculture and Technology, Tokyo (Japan)); Suzuki, A.; Kobayashi, S.; Horigome, T.; Tanaka, T. 3 Dec 1992. 305p. (In Japanese). From 1992 Japan Solar Energy Society, Japan Wind Energy Association joint converence; Osaka (Japan); 3-4 Dec 1992. In *1992 JSES (Japan Solar Energy Society)/JWEA (Japan Wind Energy Association) Joint Conference.* Order Number DE93793955. Source: OSTI; NTIS (US Sales Only).

With an objective of utilizing solar energy effectively, this paper discusses theoretically a system to supply heat and electric power simultaneously using thermoelectric devices. The system consists of a collector, thermoelectric elements, power loads, thermal loads, and piping and conductors to link them. The heat collected by the collector is conducted to the thermoelectric elements which in turn heat the high-temperature side junctions. Electric potential generated from temperature difference in the elements is taken out externally as electric power. The low-temperature side junctions are also linked with piping, and supply heat to the thermal loads. Because the collected energy turns into electric power and heat finally, the overall system efficiency agrees with the collector efficiency, which can be superior to that in solar cells if a collector with superior performance even at elevated temperatures is used. A conventional light-heat hybrid system comprising a collector and solar cells exhibits high efficiency when the collector temperature is close to the air temperature, but the efficiency drops sharply at elevated temperatures. On the other hand, the present system has less efficiency reduction even at high temperatures and provides increased power generation ratio. The system can cover wide applicable temperature ranges, and can be used suitably for simultaneous heat and power supply. 8 refs., 6 figs., 2 tabs.

23257 (CONF-921276–, pp. 211-214) **Optimum design of composite panel with photovoltaic-thermo module.** Sasamoto, Y. (Science University of Tokyo, Tokyo (Japan)); Hirata, Y.; Tani, T.; Kadotani, K.; Takahashi, Y. 3 Dec 1992. 305p. (In Japanese). From 1992 Japan Solar Energy Society, Japan Wind Energy Association joint converence; Osaka (Japan); 3-4 Dec 1992. In *1992 JSES (Japan Solar Energy Society)/JWEA (Japan Wind Energy Association) Joint Conference.* Order Number DE93793955. Source: OSTI; NTIS (US Sales Only).

Photovoltaic-thermo modules were fabricated on a trial basis by combining solar cells with thermoelectric elements that utilize the Peltier effect. Solar cell modules were attached on one side of a heat dissipating sink, and thermoelectric modules operating thereon were fixed on the opposite side. The panel can perform radiation air conditioning by changing the power polarities. An experiment was carried out with a heater that simulates solar cell temperatures attached on one side and thermoelectric elements on the other side, each connected with a DC power supply. Investigations were conducted on the following three cases: (1) Power corresponding to an insolation intensity Ig is supplied only to the heater, varying the panel inclination angle; (2) power is supplied only to the thermoelectric elements for radiation air conditioning; and (3) solar cell output corresponding to Ig is supplied to the thermoelectric elements and at the same time the heater power is supplied to simulate temperature differences between the solar cells and the air temperature. Basic electrical and thermal characteristics were derived. Inclining the panel provided a good heat dissipating effect, and temperature reduction in the heat sink during room heating operation gave a favorable effect on the output. 2 refs., 11 figs., 1 tab.

23258 (DOE/CH/10093–210) **Photovoltaics: Contract lists, fiscal year 1992.** National Renewable Energy Lab., Golden, CO (United States). Mar 1993. 112p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-83CH10093. Order Number DE93000093. Source: OSTI; NTIS; GPO Dep.

US DOE's Photovoltaics Program has helped photovoltaic technologies evolve from materials and concepts in laboratories to competitive products rolling off automated assembly lines. The program is working to expand industrial capacity while continuing basic and applied technology R and D. This document is a tabulation of photovoltaics R and D that were begun, continued, or completed during this period. National laboratories or industrial, academic, and nonprofit research institutions perform the RR and D activities. The document is organized first by directing organization, then by project title and individual task. Each listing provides the name of contractor, period of performance, funding, objectives, accoplishments, and FY 1993 milestones. An index of contractors is included. (DLC)

23259 (DOE/ER/13188–8) **Nitrogen control of chloroplast differentiation: Annual progress report.** Schmidt, G.W. Georgia Univ., Athens, GA (United States). Research Foundation. Jul 1992. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG09-84ER13188. Order Number DE93015558. Source: OSTI; NTIS; GPO Dep.

This project is directed toward understanding how the availability of nitrogen affects the accumulation of chloroplast pigments and proteins functioning in energy transduction and carbon metabolism. Molecular analyses performed with Chlamydomonas reinhardtii grown in a continuous culture system such that ammonium concentration is maintained at a low steady-state concentration so as to limit cell division. As compared to chloroplasts from cells of nonlimiting nitrogen provisions, chloroplasts of N-limited cells are profoundly chlorophyll-deficient but still assimilate carbon for deposition of as starch and as storage lipids. Chlorophyll deficiency arises by limiting accumulation of appropriate nuclear-encoded mRNAs of and by depressed rates of translation of chloroplast mRNAs for apoproteins of reaction centers. Chloroplast translational effects can be partially ascribed to diminished rates of chlorophyll biosynthesis in N-limited cells, but pigment levels are not determinants for expression of the nuclear light-harvesting protein genes. Consequently, other signals that are responsive to nitrogen availability mediate transcriptional or post-transcriptional processes for accumulation of the mRNAs for LHC apoproteins and other mRNAs whose abundance is dependent upon high nitrogen levels. Conversely, limited nitrogen availability promotes accumulation of other proteins involved in carbon metabolism and oxidative electron transport in chloroplasts. Hence, thylakoids of N-limited cells exhibit enhanced chlororespiratory activities wherein oxygen serves as the electron acceptor in a pathway that involves plastoquinone and other electron carrier proteins that remain to be thoroughly characterized. Ongoing and future studies are also outlined.

23260 (ETDE-mf–93792318) **Development of plant technique for large scale separation of thin films from amorphous silicon and silicon compounds. Final report.** Reuschling, R.; Mueller, B. Pfeiffer (Arthur) Vakuumtechnik, Wetzlar (Germany); Bundesministerium fuer Forschung und Technologie, Bonn (Germany). Jun 1992. 90p. (In German). Contract BMFT 0328964A. Order Number DE93792318. Source: OSTI; NTIS (US Sales Only).

The plant technology for large scale separation of amorphous silicon (a-Si:H) should be developed from the point of view of mass-production of thin film solar cells and also opto- electronic components. A modular plant concept with a high degree of automation should be achieved for this, which makes parallel operation of locks and different process reactions an the distribution of the substrate under vacuum possible. The separation of a-Si:H should occur in a 'plasma-box', which is integrated in the process reactors and makes particularly clean a- Si separation possible. To

test the plant technique, a laboratory plant consisting of a look, a process reactor and a vacuum transfer system, should be built and tested. In preliminary test and in the laboratory plant, the critical components, such as substrate fast heating, plasma box, plasma etching system forreactor cleaning, computer control etc, should be optimized. In the context of cooperation, Phototronics are controlling the process know-how and are also the pilot customer for the plant to be developed. (orig.).

23261 (Juel–2636) **Environmental impact statements in the case of research projects - the example of photovoltaic energy conversion. Vol. 5. Environmentally relevant material balances in the prodution of different types of solar cells.** Angewandte Systemanalyse. Hagedorn, G. (Forschungsstelle fuer Energiewirtschaft, Muenchen (Germany)); Hellriegel, E. Forschungszentrum Juelich GmbH (Germany). Programmgruppe Systemforschung und Technologische Entwicklung. Jun 1992. 329p. (In German). Contract BMFT 426-3590-PLI 14120. Order Number DE93791917. Source: OSTI; NTIS (US Sales Only).

The material balances during production of different types of solar cells were analyzed in cooperation with solar cell producers. Part I of this final report contains the results for conventional processes for PV module production from multicrystalline, monocrystalline and amorphous silicon. Part II discusses the possibilities of disposal and recycling of photovoltaic modules. Research has shown that there are hardly any practicable concepts in this field; new solutions must be found if photovoltaic energy conversion is to be applied on a large scale. (orig.).

23262 (LBL–33932) **Spectroscopic studies of Synechococcus sp PCC 7002 phycobilisome core mutants.** Gindt, Y.M. Lawrence Berkeley Lab., CA (United States). Apr 1993. 179p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. Order Number DE93013737. Source: OSTI; NTIS; GPO Dep.

The role of the L_{cm} (I), β^{18} (II), and α^{AP-B} (III) chromoproteins in the phycobilisome (PBS) core was investigated using genetically engineered strains of Synechococcus missing different polypeptides. Intact cells, isolated PBS, and subcore preparations for each mutant were studied to determine the effect of that mutation on energy transfer within the PBS core and to the reaction centers. Three mutants lacked the II and/or III polypeptides, while the I chromophore was altered in others. A lower energy absorbing chromophore, A_{max} = 695 nm, was substituted for the I chromophore. The deletion of the II and III subunits had no discernible effect on energy transfer from the PBS to PSII. In cells and isolated PBS, the altered I chromophore acts to quench the PBS complex and to redirect the energy which would be transferred to PSII. In the PBS and subcore preparations, deletion of the III subunit did not alter energy transfer within the core. The deletion of the II subunit from the PBS caused a small decrease in the excited state lifetimes of the final emitters indicating more disorder within the core. The I chromophore was found to absorb at 670nm and to emit at 683nm within the intact PBS. The II chromophore emits at 679nm while the III chromophore emits at 682nm. A strong interaction exists between the I chromophore and the II subunit. Upon deletion of the II subunit from the PBS core, the I chromophore emits at a higher energy. The II subunit could act to stabilize the I chromophore-binding pocket, or exciton coupling could be occurring between the two. The role of the III chromophore is still unclear at this time. The III chromophore does contribute to the RT emission of the isolated PBS, but it transfers energy to I at 77 K. One can conclude that the III subunit is adjacent to the trimer containing the I polypeptide.

23263 (NREL/TP–410-5335) **Photovoltaic Subcontract Program: Annual report, FY 1992.** National Renewable Energy Lab., Golden, CO (United States). Mar 1993. 319p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-83CH10093. Order Number DE93000092. Source: OSTI; NTIS; GPO Dep.

This report summarizes the fiscal year (FY) 1992 progress of the subcontracted photovoltaic (PV) research and development (R&D) performed under the Photovoltaic Advanced Research and Development Project at the National Renewable Energy Laboratory (NREL)-formerly the Solar Energy Research Institute (SERI). The mission of the national PV program is to develop PV technology for large-scale generation of economically competitive electric power in the United States. The technical sections of the report cover the main areas of the subcontract program: the Crystalline Materials and Advanced Concepts project, the Polycrystalline Thin Films project, Amorphous Silicon Research project, the Photovoltaic Manufacturing Technology (PVMaT) project, PV Module and System Performance and Engineering project, and the PV Analysis and Applications Development project. Technical summaries of each of the subcontracted programs provide a discussion of approaches, major accomplishments in FY 1992, and future research directions.

23264 (NREL/TP–411-5453) **Continuous roll-to-roll a-Si photovoltaic manufacturing technology: Semiannual technical progress report, 1 April 1992–30 September 1992.** Izu, M. (Energy Conversion Devices, Inc., Troy, MI (United States)). National Renewable Energy Lab., Golden, CO (United States); Energy Conversion Devices, Inc., Troy, MI (United States). Apr 1993. 52p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-83CH10093. Order Number DE93010006. Source: OSTI; NTIS; GPO Dep.

This report describes work performed by ECD to advance its roll-to-roll, triple-junction photovoltaic manufacturing technologies; to reduce the module production costs; to increase the stabilized module performance; and to expand the commercial capacity utilizing ECD technology. The 3-year goal is to develop advanced large-scale manufacturing technology incorporating ECD's earlier research advances with the capability of producing modules with stable 11% efficiency at a cost of approximately $\$1/W_p$. Major efforts during Phase I are (1) the optimization of the high-performance back-reflector system, (2) the optimization of a-Si-Ge narrow band-gap solar cell, and (3) the optimization of the stable efficiency of the module. The goal is to achieve a stable 8% efficient 0.3-m x 1.2-m (1-ft x 4-ft) module. Also, the efforts include work on a proprietary, high-deposition-rate, microwave plasma, CVD manufacturing technology; and on the investigation of material cost reduction.

23265 (NREL/TP–411-5454) **Large-area, triple-junction a-Si alloy production scale-up: Semiannual technical progress report, 17 March 1992–18 September 1992.** Oswald, R. (Solarex Corp., Newtown, PA (United States). Thin Film Div.); O'Dowd, J. National Renewable Energy Lab., Golden, CO (United States); Solarex Corp., Newtown, PA (United States). Thin Film Div. Apr 1993. 37p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-83CH10093. Order Number DE93010007. Source: OSTI; NTIS; GPO Dep.

This report describes Solarex's work to advance its photovoltaic manufacturing technologies, reduce its a-Si:H module production costs, increase module performance, and expand the Solarex commercial production capacity. Solarex will meet these objectives by improving the deposition and quality of the transport front contact; optimizing the laser patterning process; scaling up the semiconductor deposition process; improving the back-contact deposition; and scaling up and improving the encapsulation and testing of its a-Si:H modules. In the Phase 1 portion of this subcontract, Solarex focused on scaling up components of the chemical vapor deposition system for deposition of the system contact, scaling up laser scribing techniques; triple-junction recipes for module production; and metal-oxide back contacts. The goal of these efforts is to adopt all portions of the manufacturing line to handle substrates larger than 0.37 m^2.

23266 (NREL/TP–411-5456) **Optimization of transparent and reflecting electrodes for amorphous silicon solar cells: Annual subcontract report, 1 May 1991–30 April 1992.** Gordon, R.G. (Harvard Univ., Cambridge, MA (United States). Dept. of Chemistry). National Renewable Energy Lab., Golden, CO (United States); Harvard Univ., Cambridge, MA (United States). Dept. of Chemistry. Apr 1993. 101p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-83CH10093. Order Number DE93010009. Source: OSTI; NTIS; GPO Dep.

This report describes work to improve the performance of solar cells by improving the electrical and optical properties of their transparent conducting oxides (TCO) layers. Boron-doped zinc-oxide films were deposited by atmospheric pressure chemical

vapor deposition in a laminar-flow reactor from diethyl zinc, tert-butanol, and diborane in the temperature range between 300°C and 420°C. When the deposition temperature was above 320°C, both doped and undoped films have highly oriented crystallites with their c-axes perpendicular to the substrate plane. Films deposited from 0.07% diethyl zinc and 2.4% tert-butanol have electron densities between 3.5×10^{20} cm^{-3} and 5.5×10^{20} cm^{-3}, conductivities between 250 Ω^{-1} and 2500 Ω^{-1} and mobilities between 2.5 cm^2/V-s and 35.0 cm^2/V-s, depending on dopant concentration, film thickness, and deposition temperature. Optical measurements show that the maximum infrared reflectance of the doped films is close to 90%, compared to about 20% for undoped films. Film visible absorption and film conductivity were found to increase with film thickness. The ratio of conductivity to visible absorption coefficient for doped films was between 0.1 Ω and 1.1 Ω^{-1}. The band gap of the film changes from 3.3 eV to 3.7 eV when the film is doped with 0.012% diborane.

23267 (NREL/TP–411-5457) **Structural and electronic studies of a-SiGe:H alloys: Final subcontract report, 1 January 1991–28 February 1993.** Paul, W. (Harvard Univ., Cambridge, MA (United States)). National Renewable Energy Lab., Golden, CO (United States); Harvard Univ., Cambridge, MA (United States). Apr 1993. 64p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-83CH10093. Order Number DE93010021. Source: OSTI; NTIS; GPO Dep.

This report describes work to produce alloys of a-$Si_{1-x}Ge_x$:H of improved photoelectronic quality by plasma-enhanced chemical vapor deposition (PECVD). The goal was to discover optimum preparation conditions for the end-component, a-Ge:H, to establish whether modification of the usual practice of starting from a-Si:H preparation conditions was advisable. Such modification, found to be necessary, gave films of a-Ge:H with efficiency-mobility-lifetime products ($\eta\mu\tau$) 10^2 to 10^3 higher than were earlier available, in homogeneous environmentally stable material. Both a-Ge:H and a-$Si_{1-x}Ge_x$:H of large x were studied in detail. Alloy material was shown to have $\eta\mu\tau$ 10^2 larger than found earlier. However, just as the $\eta\mu\tau$ of a-Si:H decreases when Ge is added, so also the $\eta\mu\tau$ of these alloys with Si addition. By contrast, the ambipolar diffusion lengths, L_o which are governed by the hole mobility, vary by only a factor of two over the whole alloy series. Using the experimental finding of a small valence band offset between a-Si:H and a-Ge:H compositional fluctuations on a 10-mm scale are suggested to explain the behavior of $\eta\mu\tau$ and L_o The implications for eventual improvement of the alloys are profound, but require direct experimental tests of the postulated compositional fluctuations.

23268 (SAND–93-0023C) **Photocatalysis for the treatment of waste water: Applications involving the removal of metals.** Prairie, M.R.; Stange, B.M. Sandia National Labs., Albuquerque, NM (United States). [1993]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-930830–14: National conference and exposition on heat transfer, Atlanta, GA (United States), 8-11 Aug 1993). Order Number DE93011669. Source: OSTI; NTIS; GPO Dep.

This paper describes laboratory work investigating the applicability of solar-powered photocatalysis for the treatment of water contaminated with heavy metals and organics. It was found that Ag(I), Au (HI), Cr(VI), Hg(H), Pd(H), and PT(IV) are easily treated while Cd(U), Cu(II), and Ni(II) are not. The importance of the entire photocatalytic redox cycle is demonstrated by showing that the rates of oxidation (of organics) and reduction (of metals) are intrinsically interrelated. Data are presented showing that photoefficiency decreases as light intensity increases in the range of 0 to 17 suns UV. This result suggests that one-sun systems are more efficient than those using concentrated solar radiation. Preliminary data for three samples of actual waste: (1) gold mining leachate, (2) precious metals mining extract, and (3) photographic waste, are described. In general, actual applications are less effective than predicted using laboratory data for clean systems.

1406 Photovoltaic Power Systems

Refer also to citation(s) 24273

23269 (CONF-921276–, pp. 195-198) **Windmill of solar-cell blades.** Morioka, S. (CRC Research Institute Inc., Tokyo (Japan)); Kakita, Y.; Ushiyama, I. 3 Dec 1992. 305p. (In Japanese). From 1992 Japan Solar Energy Society, Japan Wind Energy Association joint converence; Osaka (Japan); 3-4 Dec 1992. In *1992 JSES (Japan Solar Energy Society)/JWEA (Japan Wind Energy Association) Joint Conference.* Order Number DE93793955. Source: OSTI; NTIS (US Sales Only).

With an objective of utilizing wind and solar energy simultaneously and complementarily, this paper proposes a solar-cell blade windmill integrating solar cells attached on a drag-type vertical-axis windmill with a large wind receiving area. The paper also considers a panel vertical to the ground since the solar cell panel of this system is a rotating body which can utilize both sides, not the sun facing side alone. Therefore, the total annual insolation amount onto the static face differs very little from that with ordinary panels. Considering the insolation incident to the face rotating with a certain angular speed, the amount of electric power generated from the solar cells was calculated. Solar-cell blade windmills may be used more effectively in areas of high latitudes. Power generation (W/m^2) from windmills of flat plate, cylinder, and Savonius types at a wind velocity of 5 m/s are 3.7, 7.5, and 15.0, respectively. Power generation (W/m^2) from silicon solar Cells attached to the windmills of the above types are 15.2, 24.0 and 16.7, respectively, the Cylinder type windmill being the largest power generator. The total power output, which is a sum of power generated from the windmill and the solar cells, results in a large increase. 5 refs., 4 figs., 5 tabs.

23270 (CONF-921276–, pp. 199-202) **Field test and simulation of photovoltaic/wind hybrid generating system.** Furuya, H. (Toyohashi University of Technology, Aichi (Japan)); Tsuchiya, Y.; Sakakibara, T. 3 Dec 1992. 305p. (In Japanese). From 1992 Japan Solar Energy Society, Japan Wind Energy Association joint converence; Osaka (Japan); 3-4 Dec 1992. In *1992 JSES (Japan Solar Energy Society)/JWEA (Japan Wind Energy Association) Joint Conference.* Order Number DE93793955. Source: OSTI; NTIS (US Sales Only).

A prototype photovoltaic/wind hybrid generating system was constructed and a series of field test and simulation was carried out for 21 days. A solar cell array with a maximum output of 80W, a 150-W wind power generator, and an auxiliary generator were connected to a storage battery (two 12V, 170-Ah batteries in series). The auxiliary generator turns on when a battery charge has fallen to 20%, and turns off when it rises to 60%. The dummy load turns on at the battery charge of 100%, and turns off at a rate below 100%. Kamishima Island was used as a model for the daytime load curves. Characteristic formulas were formulated for each device using the experimental values, and insolation, wind velocities, and daytime load patterns were inputted for simulation. The results of the field test and the simulation showed good agreement in the battery charge, voltage and charge power although some disagreement was recorded in the time for turning on and off the auxiliary generator. Delay in the generator on-off time increased when a sampling interval exceeded 40 minutes in the simulation. 6 refs., 4 figs.

23271 (NREL/TP–411-5450) **Photovoltaics for municipal planners: Cost-effective municipal applications of photovoltaics for electric power.** National Renewable Energy Lab., Golden, CO (United States). Apr 1993. 36p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-83CH10093. Order Number DE93000099. Source: OSTI; NTIS; GPO Dep.

This booklet is intended for city and county government personnel, as well as community organizations, who deal with supplying, regulating, or recommending electric power resources. Specifically, this document deals with photovoltaic (PV) power, or power from solar cells, which is currently the most cost-effective energy source for electricity requirements that are relatively small, located in isolated areas, or difficult to serve with conventional technology. Recently, PV has been documented to be more cost-effective than conventional alternatives (such as line extensions or engine generators) in dozens of applications within the service territories of electric, gas, and communications utilities. Here, we document numerous cost-effective urban applications, chosen by planners and

utilities because they were the most cost-effective option or because they were appropriate for environmental or logistical reasons. These applications occur within various municipal departments, including utility, parks and recreation, traffic engineering, transportation, and planning, and they include lighting applications, communications equipment, corrosion protection, irrigation control equipment, remote monitoring, and even portable power supplies for emergency situations.

1407 Solar Thermal Power Systems

Refer also to citation(s) 23251, 23254, 23309

23272 (SAND–92-2346C) **High-flux testing of heat pipes for point-focus solar collector systems.** Adkins, D.R. Sandia National Labs., Albuquerque, NM (United States). [1993]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-930830–13: National conference and exposition on heat transfer, Atlanta, GA (United States), 8-11 Aug 1993). Order Number DE93011581. Source: OSTI; NTIS; GPO Dep.

The Department of Energy is currently funding the development of a power conversion system that uses a parabolic-dish collector to direct solar energy onto a 25-kWe Stirling engine/generator system. As part of this program, heat-pipe solar receivers are being developed to transfer 65 kW of thermal energy from the focus of the concentrator to the heater-tubes of the engine. These receivers operate at temperaturesup to 800°C and with peak flux loads approaching 100 W/cm^2. Designing a wick structure that can withstand these operating conditions has been a major part of the heat-pipe receiver development activities. Recently, bench-scale tests were performed on two advanced artery structures that are candidates for full-scale receivers. The arteries were able to lift sodium over 40 cm to cool a 30-cm^2 patch on the bench-scale receiver's surface. Peak flux levels of approximately 80 W/cm^2 were applied to the receiver surface.

1409 Solar Thermal Utilization

Refer also to citation(s) 23293, 23804, 23806

23273 (CONF-921276–, pp. 123-126) **Thermal properties of the pressurized solar water heater.** Ohashi, K. (Nippon Electric Glass Co. Ltd., Shiga (Japan)); Tominaga, M.; Nakatani, Y.; Saito, H. 3 Dec 1992. 305p. (In Japanese). From 1992 Japan Solar Energy Society, Japan Wind Energy Association joint converence; Osaka (Japan); 3-4 Dec 1992. In *1992 JSES (Japan Solar Energy Society)/JWEA (Japan Wind Energy Association) Joint Conference.* Order Number DE93793955. Source: OSTI; NTIS (US Sales Only).

The present paper reported the structure, and thermal collection and other basic performances of city water pipe-pressurized vacuum type solar water heater which was developed in order to solve problems raised in the conventional water heater by solar heat and structure an energy saving hot water supply system to be used for a wider purpose. The water heater is built up with a copper-made thermal collection/hot water storage tube which is coated with a wavelength-selective film on its outside surface and inserted inside a glass tube. Then, space is vacuumized between both the tubes. The city water is taken from the upper header down to the bottom through the inside of thermal collection/hot water storage tube. Then, it flows in reverse outside the header. Because of vacuumized glass tube, obtained was hot water which was higher by about 25 centigrade at the maximum than that in case of the non-vacuumized one. Even in winter, hot water of 55 centigrade could be obtained under the bright sky. As for the dependency on tilt angle, the most practical one was 45° for the installation to heighten the reach temperature in winter. With a possible wide utilization of reflected sunlight radiation, the thermal collection efficiency was heightened by about 20% and 15% with a reverse surface of concrete and tiles, respectively. Also with a possible pressurizing use of hydrostatic pressure, the obtained hot water agreed well with the ideal water in saturated steam pressure curve. 2 refs., 11 figs., 1 tab.

23274 (CONF-921276–, pp. 127-130) **Appraisal of solar energy installation from view point of repaymental period.** Yui, S. 3 Dec 1992. 305p. (In Japanese). From 1992 Japan Solar Energy Society, Japan Wind Energy Association joint converence; Osaka (Japan); 3-4 Dec 1992. In *1992 JSES (Japan Solar Energy Society)/JWEA (Japan Wind Energy Association) Joint Conference.* Order Number DE93793955. Source: OSTI; NTIS (US Sales Only).

To judge whether or not the water heater is economical, economic analysis was tried of both non-concentrated plane type collector and sloped solar frame concentrator (SSFC) which was proposed as a simplified concentrator. Assuming that the repayment period of installations and equipment is generally 20 years, among which some machinery enters into a period for the repair or renewal in 15 years at the earliest, the said plant does not seem to be feasible unless it annually earn more than 5% or 1/20 of the invested amount by selling the secondary energy generated by it. The annual earning ratio to the invested installation of water heater only for the hot water supply use is about 7%, which means that the required number of repayment years (n) is 11.2. That n is enlarged to 13.8 if the above water heater is extended in performance to a plant which simultaneously heats the air in the house. If used for both air heating and hot water supply, the presently proposed SSFC is 9 in n. The n is 12.8 with a sufficient feasibility in case that the air heating, hot water supply and self-supply of power are designed to be done all together by an SSFC hybridly with solar cells. 1 ref., 2 figs.

23275 (CONF-921276–, pp. 131-134) **Reflectance and absorptance of silica gel bed used in the desiccant/regenerator.** Saito, Y. (Osaka Institute of Technology, Osaka (Japan)). 3 Dec 1992. 305p. (In Japanese). From 1992 Japan Solar Energy Society, Japan Wind Energy Association joint converence; Osaka (Japan); 3-4 Dec 1992. In *1992 JSES (Japan Solar Energy Society)/JWEA (Japan Wind Energy Association) Joint Conference.* Order Number DE93793955. Source: OSTI; NTIS (US Sales Only).

The air cooling with desiccant-using dehumidification is judged promising in the high temperature and high humidity region. In the present research, study was made of a plant to heat and regenerate adsorbent by collecting radiant sunlight directly on a desiccant bed in which the desiccant was silica gel particles as solid adsorbent. The reflectance/transmittance/absorptance model of the glazed desiccant bed was set up as follows: However with a partial reflection on the glazing, the collected light (I_C) reaches the desiccant bed after permeating the glazing. Upon the above reflection, the reflected I_C further becomes partially I_C and partially diffused light (I_D). The I_C which permeated the glazing and reached the desiccant bed partially reflects and partially becomes I_D. All the reflectance, transmittance and absorptance factors were obtained against the total sunlight radiation by experimentally obtaining the necessary values for the model analysis. As a result, the radiant quantity of sunlight to be absorbed by the desiccant layer could be obtained as a function of water content of the silica gel. 3 refs., 6 figs., 3 tabs.

23276 (CONF-921276–, pp. 135-138) **Effective thermal conductivity of a silica gel bed used in the desiccant/regenerator.** Saito, Y. (Osaka Institute of Technology, Osaka (Japan)). 3 Dec 1992. 305p. (In Japanese). From 1992 Japan Solar Energy Society, Japan Wind Energy Association joint converence; Osaka (Japan); 3-4 Dec 1992. In *1992 JSES (Japan Solar Energy Society)/JWEA (Japan Wind Energy Association) Joint Conference.* Order Number DE93793955. Source: OSTI; NTIS (US Sales Only).

The desiccant/regenerator by direct solar heat utilization was taken into concept and its regeneration characteristics were investigated. A desiccant bed fully filled with silica gel particles is used in the desiccant/regenerator and the silica gel layer directly absorbs the radiant solar heat. Then, temperature differential is generated between the upper surface and lower portion of desiccant/regenerator, and therefore, a thermal transfer by conduction exists. The effective thermal conductivity which is necessary for studying the above transfer was experimentally obtained and its relation formula was also done by making it to be a function of water content of the silica gel. The desiccant bed does not form a continuous solid system but does a discontinuous solid system filled with spherical particles of adsorbent. Therefore, a complicated thermal

transfer is generated in the desiccant bed. A non-steady one-dimensional thermal transfer was modeled through analyzing the thermal transfer mechanism. Then, the effective thermal conductivity of desiccant bed was obtained by simulation through formulating the thermal balance. Both experiment and calculation results agreed with each other. Therefore by using the results, the thermal transfer in the desiccant bed can be calculated by making it to be a function of water content of the silica gel. 4 refs., 10 figs.

23277 (CONF-921276–, pp. 143-146) **Heat transfer characteristics of underground ducts for utilizing soil heat of a greenhouse. 3rd Report.: Experiments on the porous drain pipe ducts.** Yoshioka, T. (Kumano Technical College, Mie (Japan)); Taga, M.; Ochi, T. 3 Dec 1992. 305p. (In Japanese). From 1992 Japan Solar Energy Society, Japan Wind Energy Association joint converence; Osaka (Japan); 3-4 Dec 1992. In *1992 JSES (Japan Solar Energy Society)/JWEA (Japan Wind Energy Association) Joint Conference.* Order Number DE93793955. Source: OSTI; NTIS (US Sales Only).

Through outdoor test conducted by applying drain pipes to an actual solar greenhouse, their thermal storage, recovery and other characteristics were compared with those which had resulted from the previous experiment on the conventional polyvinyl chloride (PVC) pipes. Totally nine drain pipes each of which was a 100mm inside diameter steel pipe externally covered with ventilative meshes of a net as a duct pipe were buried horizontal with an underground depth of 480mm together with a 100mm inside diameter PVC pipe buried in the mid-rank of those drain pipes. The greenhouse was covered with a pitched film. The ground soil to store the heat is silty and about 15% in average water content. In case of using the ventilative drain pipes as duct pipes, a considerable improvement was made in heat exchanging performance with the ground soil. If the crops do not exist in the greenhouse, the heat exchanging rate through ducts is lower than that in case the crops do there. However if the drain pipes are used as duct pipes, the ground soil heat can be effectively utilized with activation in heat transfer through ducts even if the crops do not exist there. The difference in temperature between the room and ground soil must be taken into account for controlling the circulation fun. 2 refs., 11 figs., 2 tabs.

23278 (CONF-921276–, pp. 163-166) **Sprinkler floting-collector-type solar pond.** Ueda, Y. (Kinki University, Osaka (Japan). Faculty of Science and Technology); Taga, M.; Matsuoka, Y. 3 Dec 1992. 305p. (In Japanese). From 1992 Japan Solar Energy Society, Japan Wind Energy Association joint converence; Osaka (Japan); 3-4 Dec 1992. In *1992 JSES (Japan Solar Energy Society)/JWEA (Japan Wind Energy Association) Joint Conference.* Order Number DE93793955. Source: OSTI; NTIS (US Sales Only).

An air-type gas engine heat pump using a solar pond as a heat source was driven to heat a mango greenhouse. The solar pond is a salt-free type being different from a salt water concentration gradient type, which was disposed with a black solar energy absorbing board on its surface to collect heat through sprinkling and circulating the pond water. When sprinkling amount is increased during summer, the pond water absorbed more heat from the absorbing board making the temperature rise large in the upper layer of the pond water during day time, thus providing high heat collecting efficiency. With less sprinkling amount, the pond water absorbed the heat insufficiently making the temperature rise smaller, resulting in reduced efficiency. With a dual roof filled with pellets for heat insulation, the nighttime reduction in temperature was less in the space over the pond suppressing nighttime heat dissipation. A heat pump is driven during winter, wherein the heat is absorbed from the pond reducing the water temperature by 2°C. The greenhouse interior was maintained at 5°C or higher, a required temperature for growing mangoes. The calorific power supplied to heat the greenhouse from among the heat absorbed from the pond was 20%, but is still more advantageous than using a heat pump utilizing low temperature atmospheric air as a heat source. 3 refs., 7 figs., 2 tabs.

23279 (CONF-921276–, pp. 167-170) **Performance of various solar ponds.** Takarayama, N. (Kinki University, Osaka (Japan). Faculty of Science and Technology); Taga, M.; Matsuoka, Y. 3 Dec 1992. 305p. (In Japanese). From 1992 Japan Solar Energy Society, Japan Wind Energy Association joint converence; Osaka (Japan); 3-4 Dec 1992. In *1992 JSES (Japan Solar Energy Society)/JWEA (Japan Wind Energy Association) Joint Conference.* Order Number DE93793955. Source: OSTI; NTIS (US Sales Only).

Performance of salt-free solar ponds other than the salt water concentration gradient type ponds was searched using indoor solar simulator experiments and theoretical calculations. Metal halide lamps producing a light closer to natural light were used as a light source. A pellet delivering type solar pond was disposed with a certain space over the heat storing water surface. A transparent dual thin film cover having a space of 8 cm was installed over the space, filled with styrofoam particles with sizes from 3 mm to 5 mm while the lamps are turned off. A surface covered type solar pond was disposed with transparent heat insulating films with air layer dually on the heat storing water surface. A surface heat collecting type solar pond had a black heat insulating board with air layer and a 100-mm heat insulating styrofoam board floated on the water surface, over which warm water in the bottom of the water layer was sprinkled and circulated. The black board absorbed the energy in the irradiated light efficiently and transferred the heat to the pond water, exhibiting the best heat collecting performance, with the equilibrium temperature having reached 53°C after eleven days. The surface covered type and the pellet delivering type ponds showed approximately the same performance. The theoretical calculations agreed approximately with the experimental values enabling to discuss the performance difference because of types and structures. 3 refs., 12 figs.

23280 (CONF-921276–, pp. 175-178) **Studies of open cycle absorption dehumidifying/drying system. Part 9.: Simulation model for a natural convective glazed solar regenerator.** Jun, L. (Waseda University, Tokyo (Japan)); Kimura, K.; Choi, K.; Orima, M.; Fukumitsu, W. 3 Dec 1992. 305p. From 1992 Japan Solar Energy Society, Japan Wind Energy Association joint converence; Osaka (Japan); 3-4 Dec 1992. In *1992 JSES (Japan Solar Energy Society)/JWEA (Japan Wind Energy Association) Joint Conference.* Order Number DE93793955. Source: OSTI; NTIS (US Sales Only).

This paper proposes a simulation model for a natural convective solar regenerator in an open cycle absorption dehumidifying/drying system. A solar regenerator has a flat tilted surface open to the atmosphere. On the surface, a dilute LiCl adsorbent solution flows from the top and becomes a dense solution towards the bottom due to a waver evaporation. The regenerated solution can be used to drive a dehumidifying/drying or an air conditioning system. The tilted surface is covered with a glazed cover. In the air space therein, water moves between a natural air convection and the dilute solution to develop condensation. Calculations have agreed well with the measurements. The evaporation rate increased linearly with the insolation. Because of large effect of the solution inlet temperature on the evaporation rate, it is desirable to reduce losses in preheat from a heat exchange and solution heat during circulation. Adequate length of the equipment may be selected on the basis of inlet flow rates and outlet yields. Under the same area and condition, the shorter the equipment length, the higher the regeneration capability. 5 refs., 9 figs., 1 tab.

23281 (CONF-921276–, pp. 179-182) **Study on the natural circulating type desalination system by the solar heat.** Kugai, K. (University of the Ryukyus, Okinawa (Japan)); Nagai, M.; Yaga, M. 3 Dec 1992. 305p. (In Japanese). From 1992 Japan Solar Energy Society, Japan Wind Energy Association joint converence; Osaka (Japan); 3-4 Dec 1992. In *1992 JSES (Japan Solar Energy Society)/JWEA (Japan Wind Energy Association) Joint Conference.* Order Number DE93793955. Source: OSTI; NTIS (US Sales Only).

This paper discusses a sea water desalination system utilizing natural vapor circulation as a result of solar heat. The system consists of an evaporator, vapor transporting pipes, and a condenser, uses solar heat as the heat source, and operates on difference in temperatures in the evaporator and the condenser. The present paper reports on the evaporator. An experiment was carried out using black painted tap water 2-inch pipes with a length of 2 m and transparent acrylic pipes of the same size as evaporators installed horizontally on an outdoor field. Installing 4-m long vertical pipes on both ends of the evaporator promotes evaporation effect 1.32 to 2 times as much as with 2-m long pipes, resulting in as high maximum evaporation efficiency as 71%. Promoting the evaporation

requires replenishing the evaporator incessantly with air with low saturation. Attaching 2-m long vertical pipes on the wick pipe evaporator with black felt fabrics inserted into transparent pipes derived an evaporation of 0.63 kg/m^2. The evaporation is subjected to effect of winds in addition to insolation, and is promoted especially with wick pipes. Evaporation in the wick pipes may be blocked with water drops generated in the evaporator. 4 refs., 10 figs., 4 tabs.

23282 (CONF-921276–, pp. 247-250) **Evaluation of performance for solar house with trombe-wall. Part 2.: Thermal performance in heating.** Nakajima, Y. (Kogakuin University, Tokyo (Japan)); Sekine, K.; Makita, T.; Watanabe, T.; Yoshida, N. 3 Dec 1992. 305p. (In Japanese). From 1992 Japan Solar Energy Society, Japan Wind Energy Association joint converence; Osaka (Japan); 3-4 Dec 1992. In *1992 JSES (Japan Solar Energy Society)/JWEA (Japan Wind Energy Association) Joint Conference*. Order Number DE93793955. Source: OSTI; NTIS (US Sales Only).

An investigation was made on thermal characteristics of a solar house with Trombe-walls when an auxiliary room heating system is used to maintain the room temperature from 19.5°C to 20.5°C. Rooms with the Trombe-walls suppressed heat loss lower than those without the walls during the daytime. The auxiliary heating system was stopped during the nighttime for sleeping comfort, but the rooms with the Trombe-walls kept the room temperature drop and the heat loss smaller. Measurements of the Trombe-wall temperatures at its inner and outer surface showed a peak temperature at its outer surface of 23.3°C at about 15:00 hours, while that at its inner surface reached 16.6°C at about 20:00, which was maintained unchanged until 23:00 when the room heating was stopped. This means that the Trombe-walls absorbed heat from the auxiliary room heating system and raised the inner surface temperature. The solar heat can be utilized more effectively if heat insulation is installed inside the Trombe-wall to reduce the loss due to absorption of the heat for room heating during the daytime when the inner Trombe-wall surface temperature is low. The heat insulation would be removed during the nighttime when the inner surface temperature has become higher than the room temperature to give off the heat into rooms after the heating system has been stopped. 5 refs., 7 figs., 3 tabs.

23283 (CONF-921276–, pp. 251-254) **Evaluation of thermal enviornment with a system for a solar house employing an air-type roof collector.** Ohashi, K. (Kogakuin University, Tokyo (Japan)); Nakamura, J.; Suzuki, K.; Sakuragi, T. 3 Dec 1992. 305p. (In Japanese). From 1992 Japan Solar Energy Society, Japan Wind Energy Association joint converence; Osaka (Japan); 3-4 Dec 1992. In *1992 JSES (Japan Solar Energy Society)/JWEA (Japan Wind Energy Association) Joint Conference*. Order Number DE93793955. Source: OSTI; NTIS (US Sales Only).

Explanation was made of an air-type solar system which blows air with collected heat under the floor. Outdoor air taken from the air suction inlet under the eaves into the roof-space is heated by a heat collecting portion (190m^2) of the roof surface. Heat is released after having been collected by the hot water supply coil in spring, summer and autumn. Blown under the floor, the hot air is released after having heated the floor board in winter. There is a hot water pipe panel heater as an auxiliary for the air heating use under the cloudy sky. A thermal collection efficiency attained to 14 to 18% against the total radiant quantity of sunlight on the horizontal surface corresponding to the heat collecting portion under the bright sky. Blown to under the floor, the air with collected heat up to 45 centigrade at the highest heated the floor surface up to about 26 centigrade and released heat to the room by convection and radiation, which resulted in giving an efficient floor heating effect. Room temperature was uniformly distributed in both vertical and horizontal directions by the air circulation and floor heating effect. The outdoor temperature and underground temperature under the building for the year were calculated by using the physical values of soil heat and fluctuant factors in outdoor meteorology. As compared with the actually measured value, the thus calculated value differed from it due to external turbulence in underground layer as shallow as 0.5m in depth. However, both the values agreed well with each other in deeper underground layers than the above. 4 refs., 11 figs., 2 tabs.

23284 (DOE/FTR–93011936) **[Travel to Spain for IEA Task 12 Subtask B, and Task 21 Subtask C model evaluation/improvement]: Foreign trip report, March 29–April 2, 1993.** Judkoff, R. National Renewable Energy Lab., Golden, CO (United States). 14 Apr 1993. 20p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-83CH10093. Order Number DE93011936. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The action items list, meeting agenda, attendees list, and list of exchanged papers are enclosed as attachments. The tasks that each participating country in this IEA program is to produce are described. (MHR)

23285 (LTKK-EN-A–16) **Solar heating of urban areas.** Saastamoinen, J.J. Lappeenranta Univ. of Technology (Finland). Dept. of Energy Technology. 1989. 76p. Order Number DE93794786. Source: OSTI; NTIS.

In the usual solar heating systems for urban areas, heat is collected by solar collectors and stored for the use of the winter. In the system considered here, the urban area itself is covered by an insulating transparent roof. The main features are the following: the temperature of the area increases due to the solar radiation, which means a decrease in the energy consumption of the heated buildings in the area. The heat losses due to conduction through the walls, due to air leakage and ventilation are decreased. The heating devices can be dimensioned smaller; the summer starts earlier and lasts longer in the covered area. Trees and other plants requiring warmer climate can be grown in the area; the area can be used as a source for low temperature heat during the summer. This heat is stored for later use. The annual operation, and the operation in different weather conditions is discussed. The effect of different parameters on the operation is considered. The solar heating with transparent roof is especially suitable for shop markets. The covered area can be used as an entrance way to the shops. The heat losses through the shop windows and due to air leakage in the opening of the shop doors is greatly decreased due to the solar energy.

23286 (NEI-DK–1152) **Use of solar heat in industry: Perspectives and possibilities for development. Final report.** Cowiconsult Raadgivende Ingenioerer A/S, Lyngby (Denmark). Mar 1993. [147p.] (In Danish). Contract ENS-51181-91.0010. Order Number DE93794690. Source: OSTI; NTIS.

A preliminary project concerning the possibilities for utilizing solar heating within industry is described. The emphasis is on an evaluation of solar collectors. A short description is given of the underlying theory of solar heating and solar collectors as a background for the understanding of efficiency curves for the latter. It is expected that energy consumption in Denmark until the year 2030 will rise by 60%, if production is doubled. If energy saving initiatives are carried out it could rise by only 15%. The use of solar energy for heating air and liquid could contribute to a further reduction in the use of fossil fuels. Based on figures from 1984, solar energy could cover ca. 14% of energy consumption in industry by 2030. Most energy savings could be achieved by using solar heat within the food industry. It is concluded that it is feasible to use solar collectors of a simple design for preheating of water and air and predicted that there are good chances of developing a market with a sound economical basis. There are good potentials for industrial use of solar energy for heating water for washing, cleaning and rinsing, but the cost of solar collectors must be reduced. Much energy is used to obtain high temperatures for industrial purposes and it is claimed that solar energy could be an important supplement. Solar collectors of suitable design have been developed for this purpose, but market promotion is needed. The publication contains a considerable number of diagrams illustrating the design of solar process heating systems and also relevant data. (AB) (83 refs.).

23287 (NREL/TP–432-5068) **DOE Solar Process Heat Program: FY1991 Solar Process Heat Prefeasibility Studies activity.** Hewett, R. National Renewable Energy Lab., Golden, CO (United States). Nov 1992. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-83CH10093. (CONF-930435–8: SOLAR '93: American Society of Mechanical Engineers (ASME)/American Solar Energy Society (ASES) joint solar energy conference, Washington, DC (United States), 22-28 Apr 1993). Order Number DE93010010. Source: OSTI; NTIS; GPO Dep.

During fiscal year (FY) 1991, the US Department of Energy (DOE) Solar Process Heat Program implemented a Solar Process Heat Prefeasibility Studies activity. For Program purposes, a prefeasibility study is an engineering assessment that investigates the technical and economic feasibility of a solar system for a specific application for a specific end-user. The study includes an assessment of institutional issues (e.g., financing, availability of insurance, etc.) that impact the feasibility of the proposed solar project. Solar process heat technology covers solar thermal energy systems (utilizing flat plate or concentrating solar Collectors) for water heating, water preheating, cooling/refrigeration, steam generation, ventilation air heating/preheating, etc. for applications in industry, commerce, and government. The studies are selected for funding through a competitive solicitation. For FY 1991, six projects were selected for funding. As of August 31, 1992, three teams had completed their studies. This paper describes the prefeasibility studies activity, presents the results from the study performed by United Solar Technologies, and summarizes the conclusions from the studies that have been completed to date and their implications for the Solar Process Heat Program.

23288 (NREL/TP–471-5099) **Economic status and prospects of solar thermal industrial heat.** Williams, T.A.; Hale, M.J. National Renewable Energy Lab., Golden, CO (United States). Dec 1992. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-83CH10093. (CONF-930435–9: SOLAR '93: American Society of Mechanical Engineers (ASME)/American Solar Energy Society (ASES) joint solar energy conference, Washington, DC (United States), 22-28 Apr 1993). Order Number DE93010004. Source: OSTI; NTIS; GPO Dep.

This paper provides estimates of the levelized energy cost (LEC) of a mid-temperature parabolic trough system for three different development scenarios. A current technology case is developed that is representative of recent designs and costs for commercial systems, and is developed using data from a recent system installed in Tehachapi, California. The second scenario looks at design enhancements to the currenttechnology case as a way to increase annual energy output and decrease costs. The third scenario uses the annual energy output of the enhanced design, but allows for cost reductions that would be possible in higher volume production than currently exist. A simulation model was used to estimate the annual energy output from the system, and the results were combined with cost data in an economic analysis model. The study indicates that R&D improvements in the current trough system show promise of reducing the (LEC) by about 40%. At higher production rates, the LEC of the solar system with R&D improvements could potentially be reduced by over 50%.

1410 Solar Collectors and Concentrators

Refer also to citation(s) 23272, 23287

23289 (CIEMAT–680) **Stretched membrane heliostats: Design and structural analysis of reflectant module and support of a heliostat of 9 m. diameter and 60 m^2 of reflectant surface.** Figarola Torres, J.M. Centro de Investigaciones Energeticas, Medioambientales y Tecnologicas (CIEMAT), Madrid (Spain). 1993. 40p. (In Spanish). Order Number DE93796632. Source: OSTI; NTIS.

After having designed and built at CIEMAT a first prototype of a stretched membrane heliostat of 3 m diameter, the design and the structural analysis of the different components included in the reflectant module and support of another heliostat, this one of 9 m. diameter and 60 m^2. of reflectant surface, are shown in this report. This last heliostat will be mounted on a pedestal and its driving devices at the Solar Platform of Almeria. In order to optimize design and performance, the structural analysis of its basic components has been analyzed with the finite elements program ANSYS. The following elements have been subject to analysis: the membrane and their ring supports, stretching system and the structural support. A similar scheme to the one applied to the previous prototype has been used on the focus control system. That includes a linear transducer, a variable frequency and a fan. Finally it has to be pointed out that substantial improvements have been achieved with respect to the first prototype concerning design and cost. (Author)

23290 (CONF-921276–, pp. 147-150) **Thermal response of low heat loss thermal insulation pipe for cyclic temperature fluctuation.** Doi, T. (Electrotechnical Laboratory, Tsukuba (Japan)); Takashima, T.; Tanaka, T.; Fujii, T.; Kamoshida, J. 3 Dec 1992. 305p. (In Japanese). From 1992 Japan Solar Energy Society, Japan Wind Energy Association joint converence; Osaka (Japan); 3-4 Dec 1992. In *1992 JSES (Japan Solar Energy Society)/JWEA (Japan Wind Energy Association) Joint Conference.* Order Number DE93793955. Source: OSTI; NTIS (US Sales Only).

Supposing that the radiant quantity of sunlight fluctuates, respondency to temperature was both numerically and simplifiedly analyzed of thermal insulation pipe (TIP) made of insulating material only against the cyclic fluctuation in temperature. For the pipe system analysis modeling, selection was made of both conventional ordinary insulation pipe (OIP) which is a metallic pipe externally covered with insulating material and TIP which is made of insulating material only without metallic material. In the numerical analysis, basic formula of energy was obtained in the non-steady state of both fluid and insulating material, while for the response to temperature, investigation was made on the gain and phasic differential of fluid temperature at the inlet. It was known that the TIP is nearly equal to the perfect TIP in respondency to temperature with a quicker transfer of temperature differential from the inlet to the outlet than that in the OIP, and that the damping is small in amplitude of temperature differential. The TIP is larger in gain and small in phasic differential than the OIP so that the former is better in respondency to temperature. As a result of comparing the analytical solution with the numerical solution which was obtained by simplifying the basic formula of TIP for the respondency to temperature, both solutions agreed with each other in tendency of gain and phasic differential itself. 3 refs., 6 figs.

23291 (CONF-921276–, pp. 243-246) **Developing solar collecting system condensing and transmitting a large capacity of solar energy. 1st Report.** Furuune, H. (La Foret Engineering Co. Ltd., (Japan)); Yokota, J.; Hara, K.; Takahashi, K.; Koizumi, F. 3 Dec 1992. 305p. (In Japanese). From 1992 Japan Solar Energy Society, Japan Wind Energy Association joint converence; Osaka (Japan); 3-4 Dec 1992. In *1992 JSES (Japan Solar Energy Society)/JWEA (Japan Wind Energy Association) Joint Conference.* Order Number DE93793955. Source: OSTI; NTIS (US Sales Only).

This paper describes development of a large-capacity solar collecting system using fresnel lens collection and optic fiber transmission. The fresnel lens has a regular hexagonal shape and a focal distance of 128 mm (72 cm^2). One hundred ninety six of the lenses were arranged densely to make a panel with a total light receiving area of 1.4 m^2. Each lens is connected at its focal point with an input terminal of the single-core optic fiber to collect the solar rays. The core for the optic fiber is made of quartz glass, and the fiber is clad with transparent fluorine resin cladding. The transmitted outgoing rays were visible rays nearly close to the solar rays. Setting the optic fibers at the focal points of the visible rays resulted in reduced ultraviolet and infrared rays. While the amount of outgoing light varies with the sun's latitude and air masses, an amount of about 30,000 lm can be obtained when the direct solar radiation is assumed at 80,000 lx and the transmission efficiency at 20% to 30%. The present system which has the light collecting and transmission efficiency of 25% can deliver a transmitted light of 250 W when the insolation is 700 W/m^2. 4 refs., 7 figs., 2 tabs.

1420 Heat Storage

Refer also to citation(s) 23691

23292 (CONF-921276–, pp. 183-186) **Evaluation of solar heating system with thermal core type soil heat storage. Part 1.** Nakajima, Y. (Kogakuin University, Tokyo (Japan)); Yoshida, N. 3 Dec 1992. 305p. (In Japanese). From 1992 Japan Solar Energy Society, Japan Wind Energy Association joint converence; Osaka (Japan); 3-4 Dec 1992. In *1992 JSES (Japan Solar Energy Society)/JWEA (Japan Wind Energy Association) Joint Conference.* Order Number DE93793955. Source: OSTI; NTIS (US Sales Only).

This paper describes simulations of performance of a solar heating system with thermal core type soil heat storage. The system combines a thermal core consisting of a water tank and crushed

stones with soil surrounding the water tank as the heat storage media to recover heat for an extended or limited period of time. Solar heat thus stored is used as a heat source for floor-type room heating and heat pumps using air as a heat source, and then recovered. Efficiency for solar heat collection and soil heat storage is higher with the shorter heat storing period, but on the other hand this condition leads to more intensive heat pump operation because of insufficient temperature rise in the heat storage tank, thus the COP for room heating decreases. Conversely in a long period heat storage, the heat collection performance falls but the room heating efficiency rises. The larger the tank capacity, the more the solar heat collection and storage efficiency increases, but the room heating COP decreases. A preferable shape for the soil heat storage is such that the area of contact with the soil can be made as large as possible and can suppress heat loss from the ground surface around the tank. While this system was verified effective, a balance between the solar heat collection performance and the room heating efficiency, contradicting with each other, is a critical requirement for the system design. 3 refs., 8 figs.

23293 (CONF-921276–, pp. 187-190) **Study on optimization of the system parameter of the ground thermal storage in the greenhouse.** Nakahara, N. (Nagoya University, Nagoya (Japan)); Zheng, M. 3 Dec 1992. 305p. (In Japanese). From 1992 Japan Solar Energy Society, Japan Wind Energy Association joint converence; Osaka (Japan); 3-4 Dec 1992. In *1992 JSES (Japan Solar Energy Society)/JWEA (Japan Wind Energy Association) Joint Conference.* Order Number DE93793955. Source: OSTI; NTIS (US Sales Only).

This paper presents simulation numerical models for vegetable cultivating greenhouses that operate on solar energy stored in soil. The models are intended to deal with a condition with vegetables existing in a greenhouse. Greenhouse environment simulation models were built according to heat and water balance in various parts of the greenhouse. The result was 31 simultaneous equations. As a result of inducing and introducing analysis solutions for insolation and long-wave radiation to decrease the calculation time, the number of equations was decreased to six. A condition with plants present in the greenhouse produces more steam from the plants in day time than the case without plants, increasing the latent heat storage ratio. During night-time heat dissipation, the steam pressure in the room is kept higher than that in the duct, thus no water can evaporate from the duct, and sensible heat dissipation becomes predominant. For the switching on-off control according to room temperatures, the rate of solar heat utilization as a result of using the ducts is 10% to 35%, which increases as the set temperature reduces. The result coefficient is 2.1 to 5.3. If added with compound control with the air temperature difference at the duct inlet and outlet set at 0.5°C or higher, the result coefficient becomes constant at about 2.42. 2 refs., 2 figs., 5 tabs.

23294 (CONF-921276–, pp. 191-194) **Basic investigation on solar thermochemical heat storage and temperature history of reactant pellet under dehydration.** Fujii, I. (Meiji University, Tokyo (Japan)); Akiyama, S. 3 Dec 1992. 305p. (In Japanese). From 1992 Japan Solar Energy Society, Japan Wind Energy Association joint converence; Osaka (Japan); 3-4 Dec 1992. In *1992 JSES (Japan Solar Energy Society)/JWEA (Japan Wind Energy Association) Joint Conference.* Order Number DE93793955. Source: OSTI; NTIS (US Sales Only).

This paper describes a basic investigation on solar heat storage using thermochemical reaction of dehydration/hydration in Ca(OH)2. Solar rays reflected on a solar ray collector heat the outer surface of a vertical heating tube with an inner diameter of 12 mm. The tube is filled with spherical Ca(OH)2 pellets with a diameter of 10 mm, which drop down in the tube with their dropping speed so adjusted as to complete dehydration before reaching the tube end. The dehydrated pellets are exposed to steam, as required, to recover and utilize heat generated from hydration heat generating reaction, and then reused. To prevent the pellets from breakdown, Ca (OH)2 was filled into cavity in foamed metal formed spherical. Temperature behavior of the spherical pellets was investigated during the dehydration. When calculated theoretically assuming the biot number to be 0.4, the temperature change in the pellets agreed well with the experimental values. The pellets required 25 minutes before completely dehydrated. While a passing time of 30 minutes suffices for dehydration when the heating tube temperature is 600°C, decreasing the dehydration time requires to increase the amount of surface radiation heating. 4 refs., 9 figs., 2 tabs.

1440 Legislation and Regulations

23295 (DOE/BP–2015) **Wind/solar: A regulatory guide to leasing, permitting, and licensing in Idaho, Montana, Oregon, and Washington.** Bain, D. (Oregon State Dept. of Energy, Salem, OR (United States)); Bloomquist, R.G. USDOE Bonneville Power Administration, Portland, OR (United States); Oregon State Dept. of Energy, Salem, OR (United States); Washington State Energy Office, Olympia, WA (United States). Dec 1992. 177p. Sponsored by USDOE, Washington, DC (United States). DOE Contract BI79-91BP16067. Order Number DE93012372. Source: OSTI; NTIS; GPO Dep.

This handbook is one of a series that was recently written or updated for persons involved in the development of generating plants that use renewable resources. Other siting handbooks cover facilities powered by geothermal, hydro, and biomass resources. These handbooks are intended to introduce the reader to the regulations and their corresponding institutions that affect the development of physical facilities. The handbooks, for the most part, apply to resource development in the Pacific Northwest, i.e., Oregon, Washington, Idaho, and Western Montana. Some states have their own development or siting handbooks. These may be identified and obtained by contacting the states' energy offices.

15 GEOTHERMAL ENERGY

23296 (DOE/CH/10093–182) **Geothermal energy: 1992 program overview.** National Renewable Energy Lab., Golden, CO (United States). Apr 1993. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-83CH10093. Order Number DE93000024. Source: OSTI; NTIS; GPO Dep.

Geothermal energy is described in general terms with drawings illustrating the technology. A map of known and potential geothermal resources in the US is included. The 1992 program activities are described briefly. (MHR)

1501 Resources and Availability

Refer also to citation(s) 23303

1502 Geology and Hydrology of Geothermal Systems

Refer also to citation(s) 23297

1503 Geothermal Exploration and Exploration Technology

Refer also to citation(s) 22783, 24952, 24953

23297 (LA-SUB–93-177) **Report on dipole-dipole resistivity and technology transfer at the Ahuachapan Geothermal field Ahuachapan, El Salvador.** Fink, J.B. (Geophynque International, Tucson, AZ (United States)). Los Alamos National Lab., NM (United States); Geophynque International, Tucson, AZ (United States). Aug 1988. 54p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract W-7405-ENG-36. Order Number DE93012919. Source: OSTI; NTIS; GPO Dep.

The Ahuachapan Geothermal Field (AGF) is a 90 megawatt geothermal-sourced powerplant operated by the Comision Ejecutiva Hidroelectrica del Rio Lempa (CEL) of El Salvador. During the period November 1987 through May 1988 a deep resistivity survey and technology transfer was performed at the AGF at the request of Los Alamos National Laboratory (LANL) as part of a United States Agency for International Development (USAID) project. The resistivity surveying is ongoing at the time of this report under the supervision of CEL personnel. LANL and contract personnel were present at the site during performance of the initial surveying for

the purpose of technology transfer. This report presents the results and interpretation of the two initial resistivity survey lines performed on site during and shortly after the technology transfer period.

1504 Legislation and Regulations

23298 (DOE/BP–00425-2) **A regulatory guide to leasing, permitting, and licensing in Idaho, Montana, Oregon, and Washington.** Bloomquist, R.G. (Washington State Energy Office, Olympia, WA (United States)). Washington State Energy Office, Olympia, WA (United States); Idaho Dept. of Water Resources, Boise, ID (United States); Montana Dept. of Natural Resources and Conservation, Helena, MT (United States); Oregon State Dept. of Energy, Salem, OR (United States). Oct 1991. 290p. Sponsored by USDOE, Washington, DC (United States). DOE Contract BI79-91BP16067. Order Number DE93012371. Source: OSTI; NTIS; GPO Dep.

The actual geothermal exploration and development may appear to be a simple and straightforward process in comparison to the legal and institutional maze which the developer must navigate in order to obtain all of the federal, state, and local leases, permits, licenses, and approvals necessary at each step in the process. Finally, and often most difficult, is obtaining a contract for the sale of thermal energy, brine, steam, or electricity. This guide is designed to help developers interested in developing geothermal resource sites in the Bonneville Power Administration Service Territory in the state of Idaho, Montana, Oregon, and Washington better understand the federal, state, and local institutional process, the roles and responsibilities of each agency, and how and when to make contact in order to obtain the necessary documents.

1505 Economic, Industrial, and Business Aspects

23299 (DOE/BP–2013) **Economic impacts of geothermal development in Whatcom County, Washington.** Lesser, J.A. Washington State Energy Office, Olympia, WA (United States). Jul 1992. 51p. Sponsored by USDOE, Washington, DC (United States). DOE Contract BI79-90BP08317. Order Number DE93012375. Source: OSTI; NTIS; INIS; GPO Dep.

This report estimates the local economic impacts that could be anticipated from the development of a 100 megawatt (MW) geothermal power plant in eastern Whatcom County, Washington, near Mt. Baker, as shown in Figure 1. The study was commissioned by the Bonneville Power Administration to quantify such impacts as part of regional confirmation work recommended by the Northwest Power Planning Council. Whatcom County was chosen due to both identified geothermal resources and developer interest. The analysis will focus on two phases: a plant construction phase, including well field development, generating plant construction, and transmission line construction; and an operations phase. Economic impacts will occur to the extent that construction and operations affect the local economy. These impacts will depend on the existing structure of the Whatcom County economy and estimates of revenues that may accrue to the county as a result of plant construction, operation, and maintenance. Specific impacts may include additional direct employment at the plant, secondary impacts from wage payments being used to purchase locally produced goods and services, and impacts due to expenditures of royalty and tax payments received by the county. The basis for the analysis of economic impacts in this study is the US Forest Service IMPLAN input-output modeling system.

23300 (DOE/BP–2014) **Economic impacts of geothermal development in Skamania County, Washington.** Lesser, J.A. Washington State Energy Office, Olympia, WA (United States). Jul 1992. 49p. Sponsored by USDOE, Washington, DC (United States). DOE Contract BI79-90BP08317. Order Number DE93012373. Source: OSTI; NTIS; INIS; GPO Dep.

This report estimates the local economic impacts that could be anticipated from the development of a 100 megawatt (MW) geothermal power plant in eastern Skamania County, Washington, near Mt. Adams, as shown in Figure 1. The study was commissioned by the Bonneville Power Administration to quantify such impacts as part of regional confirmation work recommended by the Northwest Power Planning Council. Skamania County was chosen due to both identified geothermal resources and developer interest. The analysis will focus on two phases: a plant construction phase, including well field development, generating plant construction, and transmission line construction; and an operations phase. Economic impacts will occur to the extent that construction and operations affect the local economy. These impacts will depend on the existing structure of the Skamania County economy and estimates of revenues that may accrue to the county as a result of plant construction, operation, and maintenance. Specific impacts may include additional direct employment at the plant, secondary impacts from wage payments being used to purchase locally produced goods and services, and impacts due to expenditures of royalty and tax payments received by the county. The basis for the analysis of economic impacts in this study is the US Forest Service IMPLAN input-output modeling system.

23301 (DOE/BP–07129-3) **Economic impacts of geothermal development in Malheur County, Oregon.** Sifford, A.; Beale, K. Oregon State Dept. of Energy, Salem, OR (United States). Jan 1993. 40p. Sponsored by USDOE, Washington, DC (United States). DOE Contract BI79-90BP07129. Order Number DE93011648. Source: OSTI; NTIS; INIS; GPO Dep.

This study provides local economic impact estimates for a 100 megawatt (MW) geothermal power project in Oregon. The hypothetical project would be in Malheur County, shown in Figure 1. Bonneville Power Administration commissioned this study to quantify such impacts as part of regional confirmation work recommended by the Northwest Power Planning Council and its advisors. Malheur County was chosen as it has both identified resources and industry interest. Local economic impacts include direct, indirect, and induced changes in the local economy. Direct economic impacts result from the costs of plant development, construction, and operation. Indirect impacts result from household and local government purchases. Induced impacts result from continued responding as goods and services to support the households and local governments are purchased. Employment impacts of geothermal development follow a pattern similar to the economic impacts. Public service impacts include costs such as education, fire protection, roads, waste disposal, and water supply. The project assumption discussion notes experiences at other geothermal areas. The background section compares geothermal with conventional power plants. Power plant fuel distinguishes geothermal from other power sources. Other aspects of development are similar to small scale conventional thermal sources. The process of geothermal development is then explained. Development consists of well drilling, gathering system construction, power plant construction, plant operation and maintenance, and wellfield maintenance.

1508 Geothermal Power Plants

23302 (LA-UR–93-735) **Next stages in HDR technology development.** Duchane, D.V. Los Alamos National Lab., NM (United States). [1993]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930186–1: EPRI workshop on potential of HDR resources for the U.S. Electric Utility Industry, Philadelphia, PA (United States), 14 Jan 1993). Order Number DE93008719. Source: OSTI; NTIS; GPO Dep.

Twenty years of research and development have brought HDR heat mining technology from the purely conceptual stage to the establishment of an engineering-scale heat mine at Fenton Hill, NM. In April 1992, a long-term flow test (LTFT) of the HDR reservoir at Fenton Hill was begun. The test was carried out under steady-state conditions on a continuous basis for four months, but a major equipment failure in late July forced a temporary suspension of operations. Even this short test provided valuable information and extremely encouraging results as summarized below: There was no indication of thermal drawdown of the reservoir. There was evidence of increasing access to hot rock with time. Water consumption was in the rangki of 10–12%. Measured pumping costs were $0.003 per kilowatt of energy produced. Temperature logs conducted in the reservoir production zone during and after the flow test confirmed the fact that there was no decline in the average temperature of the fluid being produced from the reservoir. In fact, tracer testing showed that the fluid was taking more indirect

pathways and thus contacting a greater amount of hot rock as the test progressed. Water usage quickly dropped to a level of 10–15 gallons per minute, an amount equivalent to about 10–12% of the injected fluid volume. At a conversion rate of 10–15%, these would translate to effective "fuel costs" of 2–3¢ per kilowatt hour of electricity production potential. The completion of the LTFT will set the stage for commercialization of HDR but will not bring HDR technology to maturity. Relatively samples extensions of the current technology may bring significant improvements in efficiency, and these should be rapidly investigated. In the longer run, advanced operational concepts could further improve the efficiency of HDR energy extraction and may even offer the possibility of cogeneration schemes which solve both energy and water problems throughout the world.

23303 (LA-UR–93-910) **Expectations for a second US Hot Dry Rock Site.** Duchane, D.V. Los Alamos National Lab., NM (United States). [1993]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930186–2: EPRI workshop on potential of HDR resources for the U.S. Electric Utility Industry, Philadelphia, PA (United States), 14 Jan 1993). Order Number DE93010707. Source: OSTI; NTIS; GPO Dep.

The worlds first hot dry rock (HDR) reservoir was created at Fenton Hill, NM in the late 1970's. Today, Fenton Hill is the site of the largest, deepest, and hottest HDR reservoir. Over the past two decades, HDR systems have also been developed in a number of other countries. However, HDR reservoirs to date have always been created as part of research and development programs aimed at understanding the fundamentals of HDR technology. The time has come to begin planning the construction of a commercial-scale facility which will show the world that HDR can be a practical source of power. The second domestic HDR facility should demonstrate that commercial production of energy from HDR is feasible at a variety of locations. Day-today operating data should provide the cost figures needed in order to unambiguously design and build future commercial HDR power production plants. Successful construction and operation of the second HDR plant will both supply needed electric power at competitive costs and set the stage for the widespread application of HDR technology both domestically and throughout the world. If preliminary work is begun promptly, it should be possible to develop a fully operational second site by 1997. The Clearlake region of northern California may be an ideal area in which to locate the second HDR site.

1509 Geothermal Engineering

Refer also to citation(s) 22853, 23302, 24269

16 TIDAL AND WAVE POWER

1608 Wave Energy Converters

Refer also to citation(s) 24273

17 WIND ENERGY

1701 Resources and Availability (Climatology)

Refer also to citation(s) 23312

23304 (CONF-921276–, pp. 267-270) **Potential wind energy resources in the kinki district: Results of survey.** Shinohara, M. (The Kansai Electric Power Co. Inc., Osaka (Japan)); Ueda, M.; Tada, S. 3 Dec 1992. 305p. (In Japanese). From 1992 Japan Solar Energy Society, Japan Wind Energy Association joint converence; Osaka (Japan); 3-4 Dec 1992. In *1992 JSES (Japan Solar Energy Society)/JWEA (Japan Wind Energy Association) Joint Conference*. Order Number DE93793955. Source: OSTI; NTIS (US Sales Only).

To engineer the wind power generation plan, a potential wind energy map in the Kinki District was prepared by computation from meteorological data collected by the AMeDAS and Kansai Electric Power. In the conventional lkm-mesh data on monthly mean wind velocity, the wind velocity had tended to be underestimated in the large altitude places, at the summits and on the ridges. Therefore, heightening was engineered in accuracy of wind velocity presumption by collecting data as many as possible in the mountainous regions. To presume the mean wind velocity, regression was multiply made by using topographical terrain factors. In case the frequency distribution of wind velocity forms a Weibull one, the monthly mean wind velocity if given determines the different quantities necessary for computing the energy density in that case, which enables computation of the monthly mean wind energy (monthly mean energy density (W/m_2) of wind passing the unit sectional area during the unit time). 500m×500m-mesh magnitudes of potential wind energy were shown by color on the map. Regions in which higher monthly mean wind velocity than 6m/s (or 4m/s) could be expected were extracted as candidate regions for the wind power generation. 3 figs.

23305 (PNL-SA–21772) **Thermally driven winds.** Whiteman, C.D. Pacific Northwest Lab., Richland, WA (United States). Apr 1993. 33p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93013284. Source: OSTI; NTIS; GPO Dep.

This presentation will summarize the present state of knowledge on slope and valley wind systems, emphasizing physical concepts and recent gains in understanding from observational programs in various parts of the world. The presentation will begin with a discussion of terminology and a summary of the characteristics and relevant physics of slope and valley wind systems. The interrelationships between slope and valley wind systems will be covered as well as the cyclical development of the wind systems during the morning transition, daytime, evening transition, and nighttime periods. The discussion will focus on key physical factors including topography, temperature structure, surface energy budgets, atmospheric heat budgets, strength of overlying flows, etc. that produce variations in wind system behavior from one topographic and climatic setting to another. Deviant wind system behavior and winds associated with special topographic features will also be discussed.

23306 (Riso-R–683(EN), pp. 23-26) **Are feasibility studies reliable at high wind energy penetration levels.** Hansen, J.C. (Dept. of Meteorology and Wind Energy, Risoe National Laboratory, Roskilde (Denmark)); Tande, J.O.G. Risoe National Lab., Roskilde (Denmark). Meteorology and Wind Energy. Mar 1993. (CONF-930315–: ECWEC'93. European community wind energy conference and exhibition, Travemuende (Germany), 8-12 Mar 1993). In *Contributions from the Department of Meteorology and Wind Energy to the ECWEC'93 conference in Travemuende, Germany*. 73p. Order Number DE93794693. Source: OSTI; NTIS; Also available from Risoe Library, P.O. Box 49, DK-4000 Roskilde, Denmark.

Many power systems around the world show economic prospects for introducing wind energy to high penetration levels. Few actual high wind energy penetration systems have been built and decisions to fund such projects have to be taken based on feasibility studies including power system modelling. This paper compares the validity of feasibility studies of high wind energy penetration projects with studies for wind energy penetration at the level of "traditional" grid connected wind farms. Differences in study techniques and possible reasons for investors scepticism towards high wind energy penetration systems are identified. By dividing uncertainties in (a) those always present in wind power projects and (b) those special for high wind energy penetration systems, real differences in project risks and uncertainties appear. The case of the capital of the Republic of Cape Verde is considered. Feasibility study uncertainties elements for high and low penetration levels are identified and quantified for the simple case excluding capacity value of wind power. Sensitivity analyses are performed. For the case studied, the uncertainty in the cost og wind energy is practically independent of the wind energy penetration level and dominated by uncertainties in wind resource predictions. (au).

23307 (Riso-R–683(EN), pp. 37-40) **Short-term prediction of local wind conditions.** Landberg, L. (Dept. of Meteorology and Wind Energy, Risoe National Laboratory (Denmark)); Watson, S.J.; Halliday, J.A.; Joergensen, J.U. Risoe National Lab., Roskilde

(Denmark). Meteorology and Wind Energy. Mar 1993. (CONF-930315--: ECWEC'93. European community wind energy conference and exhibition, Travemuende (Germany), 8-12 Mar 1993). In *Contributions from the Department of Meteorology and Wind Energy to the ECWEC'93 conference in Travemuende, Germany.* 73p. Order Number DE93794693. Source: OSTI; NTIS; Also available from Risoe Library, P.O. Box 49, DK-4000 Roskilde, Denmark.

In this paper it is shown that for a large scale electricity supply grid with a significant penetration of wind power, fossil fuel savings could be increased by up to 25% by using intelligent forecasts of wind energy production. Wind speed forecasts are made using numerical weather prediction models combined with either a physical or a statistical model taking local microscale effects into account. The forecasts are used in conjunction with a time series model which simulates the scheduling of power plant in the England and Wales electricity supply grid. Results are shown in the form of fossil fuel savings for different forecasting methods and, in addition, show the benefits of using wind speed forecasting errors to help conventional plant scheduling. (au).

1703 Legislation and Regulations

Refer also to citation(s) 23295

23308 (Riso-R--683(EN), pp. 45-48) **The Danish code of practice for loads and reliability of wind turbines.** Christensen, C.J. (The Test Station for Wind Turbines, Dept. of Meteorology and Wind Energy, Risoe National Laboratory, Roskilde (Denmark)); Hjuler Jensen, P. Risoe National Lab., Roskilde (Denmark). Meteorology and Wind Energy. Mar 1993. (CONF-930315--: ECWEC'93. European community wind energy conference and exhibition, Travemuende (Germany), 8-12 Mar 1993). In *Contributions from the Department of Meteorology and Wind Energy to the ECWEC'93 conference in Travemuende, Germany.* 73p. Order Number DE93794693. Source: OSTI; NTIS; Also available from Risoe Library, P.O. Box 49, DK-4000 Roskilde, Denmark.

The Danish Code of practice for Wind Turbines, DS-472, is described. The code is build on limit state design and uses the partial coefficient method. The level of safety (reliability) of the code is compared to the newest draft of the forthcoming IEC standard, that is under preparation. (au).

1706 Wind Energy Engineering

Refer also to citation(s) 23227, 23228, 23269, 23270, 23306

23309 (CONF-921276--, pp. 271-274) **Study of small wind turbine generation system for extreme weather condition.** Seki, K. (Tokai University, Tokyo (Japan). Research and Development Institute); Shimizu, Y.; Takanaga, T.; Okura, R.; Otani, I. 3 Dec 1992. 305p. (In Japanese). From 1992 Japan Solar Energy Society, Japan Wind Energy Association joint converence; Osaka (Japan); 3-4 Dec 1992. In *1992 JSES (Japan Solar Energy Society)/JWEA (Japan Wind Energy Association) Joint Conference.* Order Number DE93793955. Source: OSTI; NTIS (US Sales Only).

Solar cell generator-combined small wind turbine generation system was investigated for the use in high mountain regions, particularly Himalaya, Tenzan and Mongolia. Though anxiety is unnecessary about sticking of snow and ice to the blade, the temperature is rather lower than that in the Antarctic Base so that the cold resistant design is necessary against the lower temperature then -60 centigrade. The occurrence frequency of wind velocity from 10 to 20m/s is as high as 50% so that the design was conditioned by the wind velocity of 33m/s. The highest momentary wind velocity of 100m/s must be taken into consideration. The occurrence frequency of wind is 62% in its directional range between the north-west by west and south-west by west. As the environmental condition is severe, the structure was simplified and importance was attached to the stability with a fixation of yaw and pitch. The output power is 150W at 20m/s in wind velocity and the highest one is 500W at 30 m/s in it. The largest number of revolutions per minute was made resistant to 90m/s in wind velocity. Two rotors which were 1.05m in diameter and different in material were made of Al and GFRP. The performance as expected was obtained in the wind tunnel test. For the consistency between the generator and wind turbine, importance was attached to the stability even by sacrificing the wind turbine performance. The optimized pitch angle was about 22.8°. 2 refs., 10 figs., 1 tab.

23310 (EEV--93-01) **Windmill gearboxes: Reported damage 1987 - 1992.** Fisker, J. Danske Elvaerkers Forenings Udredningsafdeling (DEFU), Lyngby (Denmark). Apr 1993. 22p. (In Danish). Contract ENS-1364/91-0008. Order Number DE93794762. Source: OSTI; NTIS.

EFP-91.

Reports of damages or operational disturbances etc. with regard to the gearboxes of size 55 kW - 2000 kW windmills in Denmark were registered and analyzed in order to determine which components or designs should be improved in order to minimize future damage. A detailed survey is given of the various types of damage, and the possible causes are discussed. Suggestions of actions to take in order to avoid damage to parts of wind turbine gear cases are detailed. A method for calculating resistance to pitting corrosion at high operational temperatures is proposed. (AB).

23311 (NEI-DK--1159) **Environmental measurements - External noise. "Windflower", Denmark.** Jensen, H. Acoustica A/S, Glostrup (Denmark); Carl Bro Gruppen, Glostrup (Denmark). Feb 1993. 13p. (In Danish). Contract ENS-51171-91.0043. Order Number DE93794749. Source: OSTI; NTIS.

Results are given of the measurements and following calculations carried out, in relation to the Danish Ministry of the Environment's Executive order no. 304, on the Danish-produced wind turbine "Windflower" 4kW. The noise effect level was LWA, ref = 73,7 dB(A), ref 1 pW. Uncertainty was +- 2 dB(A). The noise in the measuring position contains clear cut tone areas around 550Hz. (AB).

23312 (Riso-R--683(EN)) **Contributions from the Department of Meteorology and Wind Energy to the ECWEC'93 conference in Travemuende, Germany.** Lundtang Petersen, E. (ed.). Risoe National Lab., Roskilde (Denmark). Meteorology and Wind Energy. Mar 1993. 73p. (CONF-930315--: ECWEC'93. European community wind energy conference and exhibition, Travemuende (Germany), 8-12 Mar 1993). Order Number DE93794693. Source: OSTI; NTIS; Also available from Risoe Library, P.O. Box 49, DK-4000 Roskilde, Denmark.

The participation of the Meteorology and Wind Energy Department in the European Community Wind Energy Conference and Exhibition (ECWEC'93) 8-12 March in Travemuende, Germany involved the presentation of 16 papers by members of the department as authors and co-authors. This report gives the full set of papers. (au) (21 tabs., 98 ills., 88 refs.).

23313 (Riso-R--683(EN), pp. 5-8) **A 10 sec. forecast of wind turbine output with neural networks.** Tande, J.O.G. (Dept. of Meteorology and Wind Energy, Risoe National Laboratory, Roskilde (Denmark)); Landberg, L. Risoe National Lab., Roskilde (Denmark). Meteorology and Wind Energy. Mar 1993. (CONF-930315--: ECWEC'93. European community wind energy conference and exhibition, Travemuende (Germany), 8-12 Mar 1993). In *Contributions from the Department of Meteorology and Wind Energy to the ECWEC'93 conference in Travemuende, Germany.* 73p. Order Number DE93794693. Source: OSTI; NTIS; Also available from Risoe Library, P.O. Box 49, DK-4000 Roskilde, Denmark.

In this paper an experiment for obtaining a 10 second forecast of the one second average output wind turbine power is described. Measured time series of one second averages of corresponding values of wind speed, wind direction and output wind turbine power are considered, and two different neural network multilayer backpropagation network (MBPN) models for providing a continuous 10 second forecast of the one second average output power are described and evaluated. The models are tested on real time series, and the results are presented and analyzed. The results of applying the different MBPN models are evaluated against each other and against a simple persistence model assuming the output power to remain constant within the forecast period. The paper indicates the usability of neural networks for short-term forecasting of wind power, and it concludes with a ranking of the different models in terms of their estimated confidence level. (au).

23314 (Riso-R–683(EN), pp. 9-14) **A theoretical and experimental investigation of new tip shapes.** Antoniou, I. (The Test Station for Wind Turbines, Risoe National Laboratory, Roskilde (Denmark)); Aagaard Madsen, H.; Schmidt Paulsen, U. Risoe National Lab., Roskilde (Denmark). Meteorology and Wind Energy. Mar 1993. (CONF-930315–: ECWEC'93. European community wind energy conference and exhibition, Travemuende (Germany), 8-12 Mar 1993). In *Contributions from the Department of Meteorology and Wind Energy to the ECWEC'93 conference in Travemuende, Germany.* 73p. Order Number DE93794693. Source: OSTI; NTIS; Also available from Risoe Library, P.O. Box 49, DK-4000 Roskilde, Denmark.

Aerodynamic noise has become one of the main issues which the wind turbine industry must deal with at the present time. One of the most important sources of aerodynamic noise from wind turbines is the blade tip region, which also affects the aerodynamic characteristics of the rotor. This paper presents preliminary results from ongoing tests conducted for a series of different tip shapes. The selection of the different shapes has mainly been based on a literature survey and results from helicopter rotors. The tests comprise load and inflow measurements, noise measurements and flow visualization recordings. A 100 kW wind turbine Tellus T-1995 is used as a test bed. The results from the different tips are to be compared to those of the rotor's standard tip. The experimental setup is presented together with load and preliminary noise measurement results. The merits and problems of the noise measurement technique adopted are also discussed. (au) (13 refs.).

23315 (Riso-R–683(EN), pp. 15-18) **Active pitch control: The controllers influcence on performance and loads of a wind turbine.** Bindner, H. (Test Station for Wind Turbines, Risoe National Laboratory (Denmark)); Madsen, P.H.; Andersen, K.; Thomsen, K.E. Risoe National Lab., Roskilde (Denmark). Meteorology and Wind Energy. Mar 1993. (CONF-930315–: ECWEC'93. European community wind energy conference and exhibition, Travemuende (Germany), 8-12 Mar 1993). In *Contributions from the Department of Meteorology and Wind Energy to the ECWEC'93 conference in Travemuende, Germany.* 73p. Order Number DE93794693. Source: OSTI; NTIS; Also available from Risoe Library, P.O. Box 49, DK-4000 Roskilde, Denmark.

The paper presents a model suitable for controller design and analysis primarily for the design of pitch controllers. The scope of the model is to be able to predict the performance of a pitch controlled turbine and to give information on loads in the drive train. Results regarding model complexity and the impact of key parameter variation are presented. (au).

23316 (Riso-R–683(EN), pp. 19-22) **Application of a general purpose navier-stokes code to wind turbine flow problems.** Madsen, H.A. (The Test Station for Wind Turbines, Risoe National Laboratory, Roskilde (Denmark)); Rasmussen, F. Risoe National Lab., Roskilde (Denmark). Meteorology and Wind Energy. Mar 1993. (CONF-930315–: ECWEC'93. European community wind energy conference and exhibition, Travemuende (Germany), 8-12 Mar 1993). In *Contributions from the Department of Meteorology and Wind Energy to the ECWEC'93 conference in Travemuende, Germany.* 73p. Order Number DE93794693. Source: OSTI; NTIS; Also available from Risoe Library, P.O. Box 49, DK-4000 Roskilde, Denmark.

The complex nature of the aerodynamics of wind turbines requires the use of advanced, state-of-the-art computational tools. The fast growth of computing power on e.g. work stations combined with the development of new iterative solvers for large matrix systems has now made Navier Stokes calculations realistic and efficient operational tool. At RISOe Navier-Stokes calculations have now been used for some time on different wind turbine flow problems. The present paper presents results on the 2D flow over an airfoil in stall and results on the steady and unsteady flow through an actuator disc which is equivalent to the dynamic inflow problem for wind turbines. (au).

23317 (Riso-R–683(EN), pp. 27-30) **Engineering design tools for wind diesel systems: Presentation and validation of the logistic modelling package.** Infield, D.G. (ERU, RAL, Oxon (United Kingdom)); Scotney, A.; Lundsager, P.; Bindner, H.; Uhlen, K.; Toftevaag, T.; Manninen, L.; Falchetta, M.; Dijk, V. van. Risoe National Lab., Roskilde (Denmark). Meteorology and Wind Energy. Mar 1993. (CONF-930315–: ECWEC'93. European community wind energy conference and exhibition, Travemuende (Germany), 8-12 Mar 1993). In *Contributions from the Department of Meteorology and Wind Energy to the ECWEC'93 conference in Travemuende, Germany.* 73p. Order Number DE93794693. Source: OSTI; NTIS; Also available from Risoe Library, P.O. Box 49, DK-4000 Roskilde, Denmark.

A design tools software package for wind diesel systems has been developed with support from the CEC JOULE programme. Work has been undertaken cooperatively by several European countries. The complete package includes modelling of both logistic and dynamic aspects of system operation. It has been designed to be user-friendly and runs on a PC. This paper describes the logistic modelling capabilities and validation against a range of different system configurations. (au).

23318 (Riso-R–683(EN), pp. 31-34) **Engineering design tools for wind-diesel systems: Presentation and validation of the modular dynamic model.** Uhlen, K. (Norwegian Electric Power Research Institute, EFI, Trondheim (Norway)): Toftevaag, T.; Bindner, H.; Lundsager, P.; Pierik, J.T.G.; Infield, D.G.; Scotney, A.; Falchetta, M. Risoe National Lab., Roskilde (Denmark). Meteorology and Wind Energy. Mar 1993. (CONF-930315–: ECWEC'93. European community wind energy conference and exhibition, Travemuende (Germany), 8-12 Mar 1993). In *Contributions from the Department of Meteorology and Wind Energy to the ECWEC'93 conference in Travemuende, Germany.* 73p. Order Number DE93794693. Source: OSTI; NTIS; Also available from Risoe Library, P.O. Box 49, DK-4000 Roskilde, Denmark.

A design tools software package for wind diesel systems has been developed with support from the CED JOULE programme. The package has been developed cooperatively by several EEC and EFTA countries. The complete package includes modelling of both dynamic and logistic aspects of system operation and runs on a PC. This paper describes the dynamic model JODYMOD and its validation against measured results from two different wind diesel systems. (au).

23319 (Riso-R–683(EN), pp. 35) **Full scale measurements in wind turbine arrays.** Taylor, G.J. (National Power, Leatherhead (United Kingdom)); Cleijne, H.; Crespo, A.; Hoejstrup, J.; Hutting, H.; Leuven, J. van. Risoe National Lab., Roskilde (Denmark). Meteorology and Wind Energy. Mar 1993. (CONF-930315–: ECWEC'93. European community wind energy conference and exhibition, Travemuende (Germany), 8-12 Mar 1993). In *Contributions from the Department of Meteorology and Wind Energy to the ECWEC'93 conference in Travemuende, Germany.* 73p. Order Number DE93794693. Source: OSTI; NTIS; Also available from Risoe Library, P.O. Box 49, DK-4000 Roskilde, Denmark.

Short communication. WIND TURBINE ARRAYS/vortex flow; WIND TURBINE ARRAYS/power losses; VELOCITY; WIND; WIND LOADS; STRESSES; WIND TURBINES; EXPERIMENTAL DATA; DENMARK; NETHERLANDS; BELGIUM; SPAIN

23320 (Riso-R–683(EN), pp. 41-44) **Stall induced vibrations.** Rasmussen, F. (Risoe National Laboratory (Denmark)); Thirstrup Petersen, J.; Winkelaar, D.; Rawlinson-Smith, R. Risoe National Lab., Roskilde (Denmark). Meteorology and Wind Energy. Mar 1993. (CONF-930315–: ECWEC'93. European community wind energy conference and exhibition, Travemuende (Germany), 8-12 Mar 1993). In *Contributions from the Department of Meteorology and Wind Energy to the ECWEC'93 conference in Travemuende, Germany.* 73p. Order Number DE93794693. Source: OSTI; NTIS; Also available from Risoe Library, P.O. Box 49, DK-4000 Roskilde, Denmark.

The paper presents some of the results of a common effort between Risoe, ECN and Garrad Hassan, supported by JOULE 1 (and for GH partly funded by the UK Department of Trade and Industry), with the aim to clarify the physical phenomena, identify the important parameters for the occurrence of stall induced vibrations and set up necessary restrictions and design guidelines for larger turbines. (au).

23321 (Riso-R–683(EN), pp. 49-52) **The importance of a good wind year to start on when building a wind farm.** Frandsen, S. (Department of Meteorology and Wind Energy, Risoe National Laboratory, Roskilde (Denmark)); Lundtang Petersen, E. Risoe National Lab., Roskilde (Denmark). Meteorology and Wind Energy. Mar 1993. (CONF-930315–: ECWEC'93. European community wind energy conference and exhibition, Travemuende (Germany), 8-12 Mar 1993). In *Contributions from the Department of Meteorology and Wind Energy to the ECWEC'93 conference in Travemuende, Germany.* 73p. Order Number DE93794693. Source: OSTI; NTIS; Also available from Risoe Library, P.O. Box 49, DK-4000 Roskilde, Denmark.

An analysis of the influence of long-term variations in annual mean wind speed on the economy of a wind power plant has be carried out, using one British and one Danish time series of wind speed extending 90 years back. The analysis shows that even if the long-term average wind speed is known precisely, natural variations in wind speed makes the final wind power plant economy a function of the year in which the project is initialized. Such variations cannot be predicted and must be treated as an uncertainty. Employing the two series of annual mean wind speeds, cost of energy was found to vary as much as ± 13% from an arbitrarily chosen mean value of 0.40 DKK/kWh. (au).

23322 (Riso-R–683(EN), pp. 53-56) **Turbulence in windfarms.** Hoejstrup, J. (Department of Meteorology and Wind Energy, Risoe National Laboratory, Roskilde (Denmark)); Courtney, M.S. Risoe National Lab., Roskilde (Denmark). Meteorology and Wind Energy. Mar 1993. (CONF-930315–: ECWEC'93. European community wind energy conference and exhibition, Travemuende (Germany), 8-12 Mar 1993). In *Contributions from the Department of Meteorology and Wind Energy to the ECWEC'93 conference in Travemuende, Germany.* 73p. Order Number DE93794693. Source: OSTI; NTIS; Also available from Risoe Library, P.O. Box 49, DK-4000 Roskilde, Denmark.

Turbulence data from three windfarms in flat and mountaneous terrain types are presented. Turbulence properties are presented in the form of covariances, spectra and probability distributions. Standard deviations and shear stresses in the windfarm are far from their wellknown equilibrium values. Velocity spectra are strongly influenced by scales of sizes comparable to the diameter of the wake. Probability distributions do not differ much from turbulence in general, they exhibit the same non-Gaussian behaviour as the undisturbed free stream turbulence. (au) (12 refs.).

23323 (Riso-R–683(EN), pp. 57-60) **Wind measurement and modelling in mountainous regions of Portugal: Preliminary results.** Restivo, A. (Dept. of Mechanical Engineering, Faculty of Engineering, University of Porto, Porto Codex (Portugal)); Petersen, E.L. Risoe National Lab., Roskilde (Denmark). Meteorology and Wind Energy. Mar 1993. (CONF-930315–: ECWEC'93. European community wind energy conference and exhibition, Travemuende (Germany), 8-12 Mar 1993). In *Contributions from the Department of Meteorology and Wind Energy to the ECWEC'93 conference in Travemuende, Germany.* 73p. Order Number DE93794693. Source: OSTI; NTIS; Also available from Risoe Library, P.O. Box 49, DK-4000 Roskilde, Denmark.

The paper presents preliminary results of the Portuguese participation in "Wind Measurement and Modelling in Complex Terrain", a multi-partner project supported by the European Community within the JOULE Programme. The activities described here were carried out by the University of Porto, Faculty of Engineering. The research programme aims at improving the present knowledge of the wind resource in regions of Portugal with complex topography. Upon the selection of relevant areas to be studied in detail, a total of ten meteorological masts were installed and are in operation since July 1991. The wind data collected until now has been processed and summary results are presented, comprising the mean wind speed and power density (at 10 m a.g.l.), the maximum recorded 10 min average and the maximum gust (3 sec. average). The report includes detailed information on the sites that are being studied, an updated summary of the recorded wind characteristics for all stations and sample preliminary results of the application of WAsP. (au).

23324 (Riso-R–683(EN), pp. 61-67) **Wind resources, part 1: The European wind climatology.** Petersen, E.L. (Risoe National Laboratory (Denmark)). Risoe National Lab., Roskilde (Denmark). Meteorology and Wind Energy. Mar 1993. (CONF-930315–: ECWEC'93. European community wind energy conference and exhibition, Travemuende (Germany), 8-12 Mar 1993). In *Contributions from the Department of Meteorology and Wind Energy to the ECWEC'93 conference in Travemuende, Germany.* 73p. Order Number DE93794693. Source: OSTI; NTIS; Also available from Risoe Library, P.O. Box 49, DK-4000 Roskilde, Denmark.

The European Wind Atlas was produced with the purpose of establishing the meteorological basis for the assessment of wind resources in the European Community. The comprehensive guidelines and computational tools which were generated together with the Atlas have constituted the basis for a number of similar studies outside the Community thereby making the calculated power production from wind turbines comparable from one country to another. The Atlas depicts through maps and tables the regional distribution of the wind resources over land, and a recent study has presented an offshore wind resource map. It appears from the Atlas that areas potentially suitable for wind energy applications are dispersed throughout all the countries of the European Community. The Commission has initiated measurements under the Joule 1 program in Northern Portugal, Spain, Italy, Greece and Ireland. This will add significantly to our understanding of the local distribution of the wind resources in mountainous terrain and thereby help to improve the model for flow over hills. Recently a comprehensive study based on wind and wave observations from commercial ships was undertaken by Deutsche Wetterdienst - Seewetteramt, Hamburg. A carful comparison between the Wind Atlas predictions and the ship statistics can be used to rank a number of near-coastal stations in the Wind Atlas. (AB).

23325 (Riso-R–683(EN), pp. 69-72) **Wind resources, part 2: Calculational methods.** Mortensen, N.G. (Meteorology and Wind Energy Department, Risoe National Laboratory, Roskilde (Denmark)); Petersen, E.L.; Landberg, L. Risoe National Lab., Roskilde (Denmark). Meteorology and Wind Energy. Mar 1993. (CONF-930315–: ECWEC'93. European community wind energy conference and exhibition, Travemuende (Germany), 8-12 Mar 1993). In *Contributions from the Department of Meteorology and Wind Energy to the ECWEC'93 conference in Travemuende, Germany.* 73p. Order Number DE93794693. Source: OSTI; NTIS; Also available from Risoe Library, P.O. Box 49, DK-4000 Roskilde, Denmark.

The Wind Atlas Analysis and Application Program represents one of several calculational methods or tools that are used routinely in the analysis of wind data and estimation of wind resources. Based on the experience gathered at Risoe it is concluded that the program works very well in relatively uncomplicated topography. Less is known about the performance in mountainous terrain, but it is concluded that high-quality wind and topographical data, as well as great attention to detail, are a prerequisite to the successful application of such models in complex terrain. A case study, using data from an ongoing measuring campaign in very complex terrain in Northern Portugal, is used to illustrate from an ongoing measuring campaign in very complex terrain in Northern Portugal, is used to illustrate the capabilities and limitations of current models. (au).

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23326 (ANL–92/2-Vol.1) **COMMIX-PPC: A three-dimensional transient multicomponent computer program for analyzing performance of power plant condensers: Volume 1, Equations and numerics.** Chien, T.H.; Domanus, H.M.; Sha, W.T. Argonne National Lab., IL (United States). Feb 1993. 121p. DOE Contract W-31109-ENG-38. Order Number DE93012174. Source: OSTI; NTIS; INIS; GPO Dep.

The COMMIX-PPC computer pregrain is an extended and improved version of earlier COMMIX codes and is specifically designed for evaluating the thermal performance of power plant condensers. The COMMIX codes are general-purpose computer programs for the analysis of fluid flow and heat transfer in complex Industrial systems. In COMMIX-PPC, two major features have been added to previously published COMMIX codes. One feature is the incorporation of one-dimensional equations of conservation of mass, momentum, and energy on the tube stile and the proper accounting for the thermal interaction between shell and tube side through the porous-medium approach. The other added feature is the extension of the three-dimensional conservation equations for shell-side flow to treat the flow of a multicomponent medium. COMMIX-PPC is designed to perform steady-state and transient. Three-dimensional analysis of fluid flow with heat transfer tn a power plant condenser. However, the code is designed in a generalized fashion so that, with some modification, it can be used to analyze processes in any heat exchanger or other single-phase engineering applications. Volume I (Equations and Numerics) of this report describes in detail the basic equations, formulation, solution procedures, and models for a phenomena. Volume II (User's Guide and Manual) contains the input instruction, flow charts, sample problems, and descriptions of available options and boundary conditions.

23327 (ANL/MCT/CP–79047) **Corrosion performance of materials in coal-combustion environments.** Natesan, K. Argonne National Lab., IL (United States). Materials and Components Technology Div. Apr 1993. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-9305135–2: 7. annual conference on fossil energy materials, Oak Ridge, TN (United States), 11-13 May 1993). Order Number DE93012904. Source: OSTI; NTIS; GPO Dep.

Reliability of components and long-term trouble-free performance of structural materials are essential for the acceptance of power-generating process that utilize coal as a feedstock- The combustion environments encompass a wide range of oxygen partial pressures, from excess-air conditions in conventional systems to air-deficient conditions in low-NO_x systems. Apart from the environmental aspects of the effluent from coal combustion, one of the concerns from the systems standpoint is the aggressiveness of the combustion environment toward the boiler structural components such as waterwall tubes and steam superheaters. The corrosion tests in this program address the combined effect of sulfur and chlorine on the corrosion response of several ASME-coded and noncoded boiler materials exposed to air-deficient and excess-air combustion conditions. Thermodynamic calculations were made to evaluate the gas chemistries that will arise from combustion of coals. The results of such calculations, coupled with oxygen-sulfur-chlorine thermochemical diagrams, were used to select gas environments for the laboratory test program. Tests were conducted at 400 and 650°C to stimulate the waterwall and superheater environments, respectively, in pulverized-coal-fired boilers. Experimental results obtained thus far indicate that both sulfur and chlorine can accelerate corrosion of ferritic and austenitic alloys; in addition, the protective capacity of the oxide scale in resisting further corrosion seems to degrade in the presence of both sulfur and chlorine.

23328 (DOE/CE/40860–1) **High performance steam systems (HPSS): Mechanical drive market assessment: Final report.** RCG/Hagler, Bailly, Inc., San Francisco, CA (United States). Oct 1991. 62p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-90CE40860. Order Number DE93014858. Source: OSTI; NTIS; GPO Dep.

RCG/Hagler, Bailly, Inc. (RCG/HBI) was retained to investigate the potential market for the high performance steam system (HPSS) in mechanical drive applications in the US industrial sector. To conduct this assessment, we undertook several activities including: (1) Identifying and characterizing the steam turbine mechanical drive market in the US industrial sector. (2) Characterizing the mechanical drive requirements by application within each industrial sector. (3) Identifying key factors and criteria used in the selection and sizing of mechanical drive systems for each industry. (4) Estimating the population of existing facilities by industry and the resulting number. of steam turbine mechanical drives. (5) Forecasting the growth by industry and resulting new market for steam turbine mechanical drives. (6) Conducting a comparative economic evaluation of HPSS mechanical drives versus conventional steam generator and steam turbine mechanical drive systems. Steam turbine mechanical drives in the industrial sector are found in several typical applications including: Compressors, Blowers, or Pumps. Steam turbine mechanical drives are found in other applications including chippers, grinders, and paper machines such as in the pulp and paper industry. Typically, large industrial plants operate a number of in steam distribution systems at different pressures and temperature. Numerous steam turbines and process applications are operated off any given steam distribution system. Higher pressure steam is typically used to run large steam turbine mechanical drive and generator units, whereas the lower pressure steam is used to drive smaller steam turbines (including those below 1,000 hp) and for low temperature heating applications such as V= heating or process heating.

23329 (DOE/MC/29234–3364) **Advanced Turbine System (ATS): Task 1, System scoping and feasibility study: Final report.** van der Linden, S. ABB Power Generation, Inc., North Brunswick, NJ (United States). Turbine Power Div. Feb 1993. 52p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC21-92MC29234. Order Number DE93000280. Source: OSTI; NTIS; GPO Dep.

Present GT(Gas Turbine) Systems are available to achieve 52% (LHV) thermal efficiencies, plants in construction will be capable of 54%, and the goal of this study is to identify incentives, technical issues, and resource requirements to develop natural gas-and coal-compatible ATS which would have a goal of 60% or greater based on LHV. The prime objective of this project task is to select a natural gas-fired ATS (Advanced Turbine System) that could be manufactured and marketed should development costs not be at issue with the goals of: (1) Coal of electricity 10% below 1991 vintage power plants in same market class and size. (2) Expected performance 60% efficiency and higher, (3) Emission levels, NO_x < 10 ppM (0.15 lb/MW-h), CO < 20 ppM (0.30 lb/MW-h), and UHC < 20 ppM (0.30 lb/MW-h). ABB screening studies have identified the gas-fueled combined cycle as the most promising full scale solution to achieve the set goals for 1988–2002. This conclusion is based on ABB's experience level, as well as the multi-step potential of the combined cycle process to improve in many component without introducing radical changes that might increase costs and lower RAM. The technical approach to achieve 60% or better thermal efficiency will include increased turbine inlet temperatures, compressor intercooling, as well a improvements in material, turbine cooling technology and the steam turbine. Use of improved component efficiencies will achieve gas-fired cycle performance of 61.78%. Conversion to coal-firing will result in system performance of 52.17%.

23330 (DOE/PC–93007525, pp. 4-11) **Combustion 2000: Planning and procuring an engineering development program.** USDOE Pittsburgh Energy Technology Center, PA (United States). 1993. In *PETC Review: Issue 7, Winter 1992–1993*. 52p. Order Number DE93007525. Source: OSTI; NTIS.

The previous six issues of the PETC Review presented a number of fossil energy research and development (R&D) efforts. In general, these projects are part of various Federal research programs and are either fully Federally funded or cost-shared. But how is a Federal program conceived and implemented? How does the Government determine what type of solicitation will be used to obtain proposals for implementing the program? Combustion 2000 is a long-term, cost-shared, Federally funded R&D effort that will help advance coal-fired power generation technology into the 21st century. Although PETC has long been involved in 'in-house' combustion research, this program was to be performed by industry. Because it is a good example of Federally funded engineering development work that will help move advanced combustion technologies into the commercial marketplace in the future, the author has chosen the Combustion 2000 program to illustrate the procurement process. 8 figs.

23331 (NEDO-P–9119) **Technology to make waste RDF and study of its applicability to the power generation system. 2.**

New Energy and Industrial Technology Development Organization, Tokyo (Japan). Mar 1992. 168p. (In Japanese). Sponsored by New Energy and Industrial Technology Development Organization, Tokyo (Japan). Order Number DE93794622. Source: OSTI; NTIS; Available from New Energy and Industrial Technology Development Organization, Sunshine 60, 30F 1-1, 3-chome, Higashi-Ikebukuro, Toshima-ku, Tokyo, Japan.

A survey is made on RDF technology, and evaluation study is made on technology to apply the RDF to the power generation system in view of economy and sociality. In case of cocombustion, it is important to grasp probability of combustion conditions, critical conditions for tube corrosion, and characteristics of combustion flue gas and combustion ash, while, in case of RDF combustion, it is important to grasp characteristics of desulfurization, desalination, etc. Further, it is needed to make bench tests, pilot tests and incineration tests by boiler. On the assumption that RDF transportation cost and ash disposal expense are burdened by a production side, the cost of power generation is estimated. The cost of equipment in case of applying RDF to a large coal-fired plant will be considerably large, and it is difficult to cover it by saving the cost of coal at an RDF cocombustion ratio less than 2% (about 300 tons/day refuse treatment volume). At RDF combustion plants, the cost of power generation will not reach the current power selling price level of the refuse fuel power generation unless its output reaches about 100MW (2000 tons/day refuse treatment volume). 9 refs., 47 figs., 39 tabs.

23332 (NEI-FI-203) **Black liquor gasification gas cleanup: Final report.** Salmenoja, K.; Mojtahedi, W. Tampella Power, Tampere (Finland). 1992. 32p. Order Number DE93794809. Source: OSTI; NTIS.

JALO Research Programme.

Integrated Gasification Combined-Cycle (IGCC) power generation is being investigated as an attractive alternative to conventional steam cycle power plant technology. In an IGCC system, the organic matter in black liquor is converted to a clean gaseous fuel suitable for combustion in a gas turbine. The inorganic products are recovered as green or white liquors to be circulated and reused. The product gas from black liquor gasification contains sulfur gases, particulates and alkali metal compounds in the aerosol form as well as in the vapour phase. All these have to be removed or their concentrations reduced to very low levels for the gas to be acceptable to the gas turbine and also to comply with environmental regulations. Moreover, alkali and sulfur have to be recovered for reuse in the pulping process. Gasification of black liquor produces high amounts of fine alkali fume, which is produced during the pyrolysis and is extremely difficult to remove by any known method, such as wet scrubbing or filtration. The condensation of these fine alkali particles on cold surfaces could also cause serious fouling and corrosion problems and may even clog the heat exchangers. The only way to remove alkali compounds from the product gas is to condense the submicron alkali particles and then to remove condensed and larger agglomerated particles by conventional methods, such as bagfilters. The recovery of alkali compounds can be carried out in a granular bed filter where the product gas is cooled down to 500 deg C and alkalis are condensed on the filter media. In addition to this, gasification air can be preheated in this device. Spent filter media can be returned back to the gasifier or dissolved in the dissolver. The results in this report clearly show the effectiveness of granular bed filters in removing alkalis from the product gas. Especially fluidized bed type granular bed filters seems to be the most suitable and offer the possibility of recovering sodium in a useful form.

23333 (OCDO-93012032) **Modification, relocation and operation of the Pedco Rotary Cascading Bed Boiler: Final report.** Long, W.H. (PEDCO, Inc., Cincinnati, OH (United States)). Ohio Coal Development Office, Columbus, OH (United States); PEDCO, Inc., Cincinnati, OH (United States). 31 Jul 1992. 232p. Sponsored by Ohio State Government, Columbus, OH (United States). Source: OSTI; Ohio Coal Development Office, 77 S. High Street, P.O. Box 1001, Columbus, OH 43266-0001 (United States).

The Pedco Rotary Cascading Bed Demonstration Boiler was moved from the closed Hudepohl plant to the Zurn plant in Erie, Pennsylvania following the completion of a license agreement between Pedco and Zurn. The modifications were completed and the boiler installed in a new test building at the North American plant in Elizabethton, Tennessee. Test operations were initiated in Dec. 1990 and concluded in January 1992. Over thirty different fuels and fuel combinations were tested including high sulfur coals, coal wastes, industrial sludges, municipal solid wastes, oils and solvents, treated wood wastes – all alone and co-fired with high sulfur coal. Based on the test results and operational observations, the following major conclusions have been drawn from the Elizabethton operations: (1) The Pedco Rotary Cascading Bed Combustion System can burn high sulfur and waste coals in an economically and environmentally acceptable manner. (2) The Pedco Rotary Cascading Bed Combustion System can burn a wide variety of fuels and fuel mixes cleanly and economically. (3) Fuels can be changed "on-the-fly" without shutting down or losing desired steam conditions. (4) Fly ash from high sulfur coal has the potential for beneficial uses as a soil Conditioner, fertilizer ingredient or construction material additive.

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Refer also to citation(s) 22736, 22740, 22758, 22765, 23738, 24103, 24264

23334 (DOE/PC/90292-T10) **Alternative formulations of regenerable flue gas cleanup catalysts: Progress report, December 1, 1992–February 28, 1993.** Mitchell, M.B.; White, M.G. Clark Atlanta Univ., GA (United States). 1993. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-90PC90292. Order Number DE93014965. Source: OSTI; NTIS; GPO Dep.

In the work done so far, we have examined the properties of adsorbents prepared by the novel method of depositing a layer of the precursor (metal acetylacetonates) on the alumina surface. These samples were activated by decomposing the precursors to their oxides. It was possible to obtain a fairly predictable trend in the SO_2 adsorption properties of the adsorbents as long as the metal acacs did not dissociate in solution. This was observed in the case of the magnesium supported samples. Lithium supported samples exhibited a high SO_2 pickup rate at low metal loadings on alumina but the incremental SO_2 pickup rate at low metal loadings on alumina but the incremental SO_2 pickup was poor; one explanation for this observation is the dissociation of Li(acac) prior to its adsorption on alumina from the solution. We decided to investigate the properties of adsorbents prepared by aqueous impregnation to investigate the virtues of non-ionizing vs. ionizing precursors. We also carried out infrared investigations of the supported lithium precursor, in an attempt to determine the nature of this material. Conductivity analyses, presented in earlier reports, suggest that the Li(acac) ionizes in methanol solution. Elemental analyses, also presented in earlier reports, indicate a carbon/lithium ratio of 1.6 for the supported precursor, much less than the value of 5 expected from the precursor stoichiometry. Based on our earlier success using infrared spectroscopy for characterization of the magnesium and copper precursors, we decided to investigate the nature of the supported lithium complex using the same technique.

23335 (DOE/PC/90361-T9) **Catalytic fabric filtration for simultaneous NO_x and particulate control: Quarterly technical progress report, October 1–December 31, 1992.** Weber, G.F.; Ness, S.R.; Laudal, D.L.; Dunham, G. North Dakota Univ., Grand Forks, ND (United States). Energy and Environmental Research Center. Feb 1993. 40p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-90PC90361. Order Number DE93014961. Source: OSTI; NTIS; GPO Dep.

The EERC approach to meeting the program objective involves the development of a catalytic fabric filter for simultaneous NO_x and particulate control. The idea of applying either permanent or throwaway catalysts to a high-temperature fabric filter for NO_x control is not new. However, advances at OCF have shown that a high-activity catalyst can be applied to a high-temperature woven glass cloth resulting in a fabric filter material that can operate at temperatures higher than the maximum operating temperatures of commercially available, coated glass fabric. The NO_x is removed

by catalytic reduction with ammonia to form nitrogen and water. The catalyst employed at this time is vanadium/titanium, but the exact catalyst composition and the unique method of applying the catalyst to high-temperature glass fabric are the property of OCF. Other catalyst options are being evaluated by OCF in order to improve catalyst performance and minimize catalyst cost. Bench-scale experimental results to date have shown that over 90% NO_x removal can be achieved, the catalyst/fabric has promising self-abrasion characteristics, and the potential exists for substantially reduced cost when compared with conventional SCR/fabric filtration technology. However, development of the technology requires further evaluation of air-to-cloth ratio, ammonia slip, SO_2 oxidation to SO_3, temperature cycling, catalyst-coated fabric preparation, fuel impacts, fabric cleaning (reverse-gas versus pulse-jet), catalyst life (poisoning and resistance to erosion), and filter performance/life (particulate control, differential pressure, and durability).

23336 (DOE/PC/90364–T6) **Flue gas conditioning for improved particle collection in electrostatic precipitators: First topical report, Results of laboratory screening of additives.** Durham, M.D. ADA Technologies, Inc., Englewood, CO (United States). 16 Apr 1993. 67p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-91PC90364. (ADA–4300-93-T1). Order Number DE93014939. Source: OSTI; NTIS; GPO Dep.

Several tasks have been completed in a program to evaluate additives to improve fine particle collection in electrostatic precipitators. Screening tests and laboratory evaluations of additives are summarized in this report. Over 20 additives were evaluated; four were found to improve flyash precipitation rates. The Insitec particle analyzer was also evaluated; test results show that the analyzer will provide accurate sizing and counting information for particles in the size range of $\leq$ 10 μm dia.

23337 (DOE/PC/90366–T6) **Characterization of air toxics from a laboratory coal-fired combustor and utility scale power plants: Quarterly progress report No. 6, January–March 1993.** Battelle, Columbus, OH (United States). Apr 1993. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-91PC90366. Order Number DE93014954. Source: OSTI; NTIS; GPO Dep.

Laboratory combustor studies were conducted at Battelle in the fall of 1992 to evaluate sampling methods and analysis techniques for air toxics generated by buming pulverized coal. These experiments were described in the fifth quarterly progress report. In this report results from additional analyses of samples are reported. Results are shown in Tables 1–8 for analysis of nitro-polycyclic aromatic hydrocarbons (nitro-PAH), oxygenated PAH (oxy-PAH), hydroxy-nitro-aromatic compounds (OH-NO2-AR/PAH), and PAH derivatives containing sulfur (PASH) and nitrogen (PANH). In the tables the two fning rates refer to the rate at which coal was fired in the laboratory fumace. The high firing rate was 5.7 g/s (45 lbs/hr), and the low firing rate was 5.3 g/s. The first letter in the sample identification refers to high (H) or low (L) coal firing rate. The second letter refers to either the hot flue samples (H) or samples collected with a Plume Simulating Dilution Sampler (D). The third letter refers to the particle size range. Size range A was about 3.3-7.1 μm. Size range B was about 0.87-3.3 Jim. Size range C was less than 0.87-3.3μm. Size range C was less than 0.87μm. The nitro-PAH data from the hot flue and PSDS vapor and particle samples are summarized in Tables 1 through 4. The data on oxy-PAH, N02-OH-AR/PAH, PASH, and PANH from the PSDS particle samples are given in Tables 5 through 8, respectively. The most abundant target oxyPAH is fluorenone. Higher concentrations were found in size C samples as compared to the size A and size B composite samples. A similar relative concentration trend was also observed for other PAH derivatives.

23338 (DOE/PC/90544–T6) **Healy Clean Coal Project, Healy FCM testing at Niro Air Pollution Control Pilot Facility: Final report.** Alaska Industrial Development and Export Authority, Anchorage, AK (United States); Joy Environmental Technologies, Inc., Houston, TX (United States). Oct 1992. 24p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC22-91PC90544. Order Number DE93014937. Source: OSTI; NTIS; GPO Dep.

In September, 1991, pilot testing was performed at the Niro Air Pollution Control Pilot Plant in Copenhagen, Denmark in support of the Healy Clean Coal Project (HCCP), which is part of the United States Department of Energy (DOE) Clean Coal Technology III Program. The HCCP is a proposed new coal fired power plant, located in Healy, Alaska. It consists of a TRW entrained combustion system, coupled with a limestone calciner, which operates in synergism with a Joy/Niro Spray Dryer Absorber (SDA) system equipped with a lime activation system that is designed to increase the utilization of the calcined product for sulfur capture in the SDA. The pilot tests, which were funded by the United States Department of Energy (DOE) and the Alaska Industrial Development and Export Authority (AIDEA), were conducted to investigate the characteristics of the TRW combustor/limestone calciner product, referred to as Flash Calcined Material (FCM) with respect to its ability to remove $S0_2$ in the Joy/Niro Activated Recycle SDA system. This report describes the pilot facility, the test objectives and methods, and the results of the tests.

23339 (DOE/PC/91284–5) **Nitration of polynuclear aromatic hydrocarbons in coal combustors and exhaust streams: Quarterly report, October 1, 1992–December 31, 1992.** Yu, L.; Dadamio, J.; Hildemann, L.; Niska, S. Stanford Univ., CA (United States). Dept. of Civil Engineering. May 1993. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-91PC91284. Order Number DE93014977. Source: OSTI; NTIS; GPO Dep.

During the period October 1, 1992 to December 31, 1992, the technical projects proceeded smoothly without any major obstacles. Regarding PAH preparation, our efforts this quarter were directed at preparing PAH samples at well-controlled extents of primary devolatilization and secondary pyrolysis from all of the coals in our project plan. Our database is now complete for a Dietz subbituminous coal, Ill. No. 6 and Pit No. 8 hvA bituminous coals, and a Lower Kittening 1v bituminous coal. For all 4 coals, weight loss, aerosol yields, and soot fractions were observed for at least 2 extents of primary devolatilization, and for extents of secondary pyrolysis which span nearly the entire range of values. PAH samples were recovered for subsequent analysis at each operating condition, so all samples for primary devolatilization and secondary pyrolysis are now in hand. For sample analysis, research this quarter focused on finalizing the prefractionation methodology. Tests were conducted to ensure that the mass determinations for the sample fractions were accurate and reproducible. Tetrahydrofuran (THF) was added as the fifth and final solvent in the prefractionation scheme. We are now able to reproducibly achieve 90% mass recovery of the Pit. No. 8 coal tar, due to the additional 10% of mass now being recovered with the THF solvent addition step.

23340 (DOE/PC/91344–T3) **Advanced separation technology for flue gas cleanup: Quarterly Technical Report No. 3, January 1993.** Gottschlich, D.E. SRI International, Menlo Park, CA (United States). 1993. 22p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-92PC91344. Order Number DE93014971. Source: OSTI; NTIS; GPO Dep.

In the fourth quarter of 1992, we continued work on Tasks 2, 3, and 4. In Task 2, we continued preparation of the reversible absorption apparatus for measuring SO_2 and NO_x solubilities. We received and installed the gas cabinet necessary for safe handling of these gases and made several modifications to the reversible absorption apparatus aimed at reducing the time required for each measurement. We also began evaluating chromatography columns for their ability to separate SO_2, N_2, and O_2. In Task 3, we synthesized three polymers of dimethylangline (DMA). The first, an oligomer of DMA, resulted in an insoluble (to most solvents) solid that is unsuitable for use as an absorbent. In order to produce a liquid material, we synthesized several DMA copolymers. A 50:50 (mole ratio) copolymer of N-phenylaziridine and propyleneimine also resulted in a solid; however, reducing the N-phenylaziridine to propyleneimine ratio to 30:70 produced a liquid at room temperature. Fourteen grams of the 30:70 copolymer were, prepared for absorption measurements. In Task 4, we performed three sets of BFC experiments. The objective of the first two sets was to determine the liquid phase mass transfer coefficient and the objective of the third set was to determine SO_2 removal efficiencies. The

Hoechst/Celanese (H/C) BFC modules were not received until late December, limiting us to prototype modules. SO_2 removal efficiencies were greater than 96% even with the prototype modules.

23341 (DOE/PC/91345–T8) **A novel carbon-based process for flue gas cleanup: Seventh quarterly technical progress report, January 1–March 31, 1993.** Gangwal, S.K. (Research Triangle Inst., Research Triangle Park, NC (United States)); Silveston, P.L. Research Triangle Inst., Research Triangle Park, NC (United States); Waterloo Univ., ON (Canada). Apr 1993. 46p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-91PC91345. Order Number DE93014956. Source: OSTI; NTIS; GPO Dep.

The objective of this project is to demonstrate the preliminary technical and economic feasibility of a novel carbon-based process for removal of at least 95 % SO_2, and at least 75 % NO_x from coal combustion flue gas. In the process, flue gas leaving the electrostatic precipitator (ESP) is passed through a trickle bed of activated carbon catalyst employing a periodic flush of low strength sulfuric acid. The SO_2 is oxidized to SO_3 and removed as medium strength sulfuric acid. The SO_2-free flue gas is then mixed with NH_3, and the NO_x in the gas is subjected to selective catalytic reduction (SCR) to N_2 over a fixed bed of activated carbon catalyst. In the previous six quarters, detailed project plans were prepared and experimental systems were commissioned. The SO_2 removal factorial experiments with BPL carbon at 21°C are well underway at Waterloo. A modified carbon catalyst (MCCI) showed up to 99% SO_2 removal in the presence of NO_x over 10 multiple cycles at 80–130°C and 1400 scc/cc/h. Several catalysts were evaluated for NO_x removal also. Promising modified carbon catalysts (MCCI, II and III) were tested. Some of these catalysts showed the potential-for over 80% NO_x removal at space velocities as high as 3000 scc/cc/h. Poisoning of NO_x removal efficiency with SO_2 in the feed was also studied. With over 100 ppm SO_2 in feed, NO_xremoval efficiency remained steady for several hours. It declined from 79% removal to 66% removal over 24 hours. NO_x removal experiments were performed with 5 different materials and the SO_2 removalactivity of 2 catalysts was tested.

23342 (DOE/PC/91346–1) **Development of the integrated environmental control model: Technical progress report, [October 1–December 31, 1992].** Rubin, E.S. Carnegie-Mellon Univ., Pittsburgh, PA (United States). Center for Energy and Environmental Studies. Jan 1993. 20p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-92PC91346. Order Number DE93015057. Source: OSTI; NTIS; GPO Dep.

In its current configuration, the IECM provides a capability to model various conventional and advanced processes for controlling air pollutant emissions from coalfired power plants before, during, or after combustion. The principal purpose of the model is to calculate the performance, emissions, and cost of power Plant configurations employing alternative environmental control methods. The model consists of various control technology modules, which may be integrated into a complete utility plant in any desired combination. in conuwt to conventional deterministic models, the IECM offers the unique capability to assign probabilistic values to all model input parameters, and to obtain probabilistic outputs in the form of cumulative distribution functions indicating the likelihood of different costs and performance results. The most recent version of the IECM, implemented on a Macintosh II computer and containing a number of software and model enhancements, was delivered to DOE/PETC at the end of the last contract in May 1991. The current contract will continue the model development effort to provide DOE/PETC with improved model capabilities, including new software developments tO facilitate model use and new technical capabilities for analysis of environmental control technologies and integrated environmental control systr,ms involving precombustion, combustion, and Post-combustion control methods. The work in this contract is divided into two phases. Phase I deals with further developing the existing version of the IECM and training PETC personnel on the effective use of the model. Phase H deals with creating new technology modules, linking the IECM with PETC databases, and training PETC personnel on the effective use of the updated model.

23343 (OCDO–93012029) **Catalytic filter bags for NO_x and particulate removal: Final report.** Kalinowski, M.R. (Owens-Corning Fiberglas Corp., Granville, OH (United States). Technical Center). Ohio Coal Development Office, Columbus, OH (United States); Owens-Corning Fiberglas Corp., Granville, OH (United States). Technical Center. Feb 1992. 64p. Sponsored by Ohio State Government, Columbus, OH (United States). Contract CDO/R-89-36. Source: OSTI; Ohio Coal Development Office, 77 S. High Street, P.O. Box 1001, Columbus, OH 43266-0001 (United States).

The approach pursued by Owens-Corning Fiberglas (OCF), under the Ohio Coal Development Office sponsorship, was to control NO_x, particulates and SO_x in one unit by using a catalyst-coated fabric. Owens-Corning Fiberglas Corporation (OCF) has demonstrated the feasibility of controlling particulates and nitrogen oxide emissions with such a fabric on a bench-scale level. In this process, NO_x emissions can be reduced by 90%. Ammonia is injected in the flue gas; in the presence of a catalyst, it reacts at 650°F with the nitrogen oxide to form nonpolluting nitrogen and water. The fabric is made of S-glass that can readily operate at the required temperature; the catalyst is coated on the fabric, using a proprietary process developed by OCF. Small scale tests had shown that the use of a glass fabric to support the catalyst permits extremely efficient use of the catalyst (10 to 100 times more efficient than present SCR technology). SO_x was eliminated by alkali injection. Combining filtration, NO_x and SO_x reduction in one operation would be significantly more economical than using a filter bag or electrostatic precipitator, an SCR unit, and a desulfurization system.

23344 (OCDO–93012030) **Study of in-duct spray drying using condensation aerosol: Final report, June 16, 1990–June 15, 1992.** Chen, W.J.R. (Ohio Univ., Athens, OH (United States)); Chang, S.M.; Adikesavalu, R. Ohio Coal Development Office, Columbus, OH (United States); Ohio Univ., Athens, OH (United States). Jun 1992. 47p. Sponsored by Ohio State Government, Columbus, OH (United States). Grant CDO/R-89-4. Source: OSTI; Ohio Coal Development Office, 77 S. High Street, P.O. Box 1001, Columbus, OH 43266-0001 (United States).

Sulfur removal efficiency of in-duct spray drying is limited by sorbent content and surface properties of the sorbent-water aerosol. It was the purpose of this study to improve the sulfur removal efficiency for in-duct spray drying by injecting condensation aerosol instead of conventional dispersion aerosol. The program was composed of three phases. In Phase I, a novel pulsed fluid bed feeder was developed and was used to feed hydrated lime for subsequent experiments. A small condensation aerosol generator was then built, which produces a lime-water condensation aerosol by condensing steam on lime particles. The results show that novel lime-water aerosols less than 10 microns were generated. The central task in Phase II was to simulate experimentally in-duct spray drying using condensation aerosols and compare the results with those using dispersion aerosols reported in the literature. A small entrained-flow reactor was constructed to simulate an in-duct spray dryer. The condensation aerosol was then introduced to the reactor at various approach to saturation temperature, calcium/sulfur stoichiometry and sulfur dioxide concentration for desulfurization study. The results show that we have improved the sulfur removal efficiency for in-duct spray drying to 90 percent or above. Thus we have met and exceeded the stated project goal of 70 percent sulfur removal. A comprehensive computer code was employed to calculate sulfur removal efficiency in Phase III.

23345 (OCDO–93013790) **Ohio Coal Development Office test program at TRW's Cleveland, Ohio entrained coal combustion facility: Final report.** Ohio Coal Development Office, Columbus, OH (United States); TRW Energy Products Group, Redondo Beach, CA (United States). Combustion Business Unit. Dec 1990. 405p. Sponsored by Ohio State Government, Columbus, OH (United States). Source: OSTI; Ohio Coal Development Office, 77 S. High Street, P.O. Box 1001, Columbus, OH 43266-0001.

The objective of the OCDO test program was to obtain maximum sulfur capture results utilizing three Ohio coals, and Ohio limestones, with practical levels of limestone injection, in-duct humidification and baghouse catch recycle. For this program, 240 tests were conducted using three Ohio coals of different sulfur content (low: 0-1.99%, medium: 2.0-2.5%, and high 2.5+%) and three

Ohio limestones. These tests demonstrated that the TRW Entrained Coal Combustor can control sulfur emissions by injecting pulverized limestone as a sorbent directly into the combustor gases entering the furnace. SO_x reduction of up to 90 percent was achieved with medium-sulfur coal (2.5% as-fired) and fine limestone (7-μm) at a calcium-to-sulfur molar ratio of 3.5. Among the conditions found to affect the reduction of sulfur emissions were: the method of limestone injection, load, calcium-to-sulfur molar ratio, sorbent particle size, coal sulfur content, and in-duct humidification. SO_x reduction was maximized by utilizing limestone injection with the flow spat evenly between two (2) injection locations. Additional tests using limestone injection gave rise to the following results: (1) In-duct humidification in combination with coarse limestone increased SO_x reduction 20 percent over the baseline condition. (2) Recycle of baghouse solids to the furnace in combination with direct new limestone feeding did not appreciably increase SO_x reduction over coarse limestone injection only. (3) NO_x emissions as low as 250 ppM were achieved. These tests showed that NO_x emissions in the Cleveland unit from Ohio coal were not a strong function of combustor stoichiometry. Lower levels are expected in utility boilers which are not refractory lined and use supplementary NO_x ports.

23346 (OCDO–93013797) **SO_x-NO_x-Rox Box systems integrations study.** Ohio Coal Development Office, Columbus, OH (United States); Babcock and Wilcox Co., Alliance, OH (United States). Research and Development Div. 7 Aug 1992. 250p. Sponsored by Ohio State Government, Columbus, OH (United States). Contract CDO/R-88-04;Contract CDR-1231. Source: OSTI; Ohio Coal Development Office, 77 S. High Street, P.O. Box 1001, Columbus, OH 43266-0001.

Recently proposed amendments to the Clean Air Act will require some utilities to retrofit pollution control equipment to existing boilers. This has generated interest in low capital cost technologies capable of simultaneously removing SO_2 and NO_x from boiler flue gases. Babcock & Wilcox's (B&W's) patented SO_x-NO_x-Rox Box (SNRB) process has been developed to provide boiler operators with a cost-effective way to simultaneously reduce emissions of particulate matter (Rox) and the oxides of sulfur (SO_x) and nitrogen (NO_x) from their coal-fired units. The SO_x-NO_x-Rox Box process offers several potential benefits: One major component; capital cost and space requirements are minimized by performing the SO_x, NO_x, and particulate removal operations in a single piece of equipment: Longer catalyst life; SO_x and particulates are removed from the flue gas stream upstream of the SCR catalyst, minimizing catalyst poisoning. pluggage and erosion concerns: Dry materials handling; reagent preparation, handling, and disposal costs are minimized because both the fresh sorbent and waste streams are dry; and "Unpromoted catalyst"; the SCR catalyst used for calcium-based SNRB systems can be an unpromoted zeolite material. This avoids the potential hazardous waste disposal concerns associated with promoted catalysts containing metals such as vanadium.

23347 (OCDO–93013798) **Advanced wet flue gas desulfurization and denitrification process, Miami Fort station: Volume 1: Final report.** Ohio Coal Development Office, Columbus, OH (United States); Cincinnati Gas and Electric Co., OH (United States); Dravo Lime Co., Pittsburgh, PA (United States). Nov 1991. 264p. Sponsored by Ohio State Government, Columbus, OH (United States). Source: OSTI; Ohio Coal Development Office, 77 S. High Street, P.O. Box 1001, Columbus, OH 43266-0001.

The Cincinnati Gas and Electric Company and Dravo Lime Company successfully completed a pilot plant testing program for the Ohio Coal Development Office. The 3 to 4.5 MW pilot system was installed at the Miami Fort station of the Cincinnati Gas and Electric Company near North Bend, Ohio, and treated a slipstream of flue gas taken from Miami Fort Unit 7. The pilot plant was designed and constructed to test improvements to the magnesium-enhanced lime wet flue gas desulfurization (MEL FGD) process. Construction of the pilot facility and testing were co-sponsored by the Ohio Coal Development Office, Cincinnati Gas and Electric Co., and Dravo Lime Company. The magnesium-enhanced lime wet FGD process, also known as the Thiosorbic® lime process, was developed by Dravo Lime Company. The project had three main objectives. The first was to test design concepts that, if proven in pilot tests and then implemented in a full-scale FGD system, could reduce the cost of equipment required for FGD. A 30 percent reduction in overall equipment cost was sought, along with reduction in operating costs. The baseline for cost reduction was the cost of a conventional limestone-based FGD system. One purpose of the project was to test concepts to improve the magnesium-enhanced lime FGD system. These concepts, if successfully tested, could lead to new design bases for MEL FGD systems.

23348 (OCDO–93013799) **Advanced wet flue gas desulfurization and denitrification process, Miami Fort station: Volume 2: Final report.** Ohio Coal Development Office, Columbus, OH (United States); Cincinnati Gas and Electric Co., OH (United States); Dravo Lime Co., Pittsburgh, PA (United States). Nov 1991. 146p. Sponsored by Ohio State Government, Columbus, OH (United States). Source: OSTI; Ohio Coal Development Office, 77 S. High Street, P.O. Box 1001, Columbus, OH 43266–0001.

Two hundred and sixty-one coal-fired electric utility generating units in the United States are affected by Phase 1 the 1990 Clean Air Act revisions. The total MW of generating capacity affected is 87,261. Dravo Lime projects that 24,400 MW will be retrofitted with wet FGD for Phase 1; in Phase 2, another 6,600 MW will be retrofitted. Forty-one of the affected units, with a total capacity of 14,343 MW, are located Ohio. Figure A1 shows the location and approximate size of these units. Table A1 lists the units and itemizes the allowable emissions. It is likely that several of the larger units in Ohio and elsewhere will be retrofitted by 1995–1997 with magnesium-enhanced lime based wet FGD, and the improvements found in the testing program could be included as part of these installations. Smaller diameter absorbers built for higher flue gas velocities would be easier to fabricate off-site and to ship by barge on the Ohio River to the plant site, as was done for the absorbers installed at the Zimmer station. Much smaller thickeners would be easier to fit onto cramped sites in retrofits.

2004 Health and Safety

Refer also to citation(s) 23517

2005 Environmental Aspects

Refer also to citation(s) 22742, 24264, 24657

23349 (ANL/EAIS/CP–78990) **Ozone nonattainment: Implications for NO_x and VOC compliance by the electric power industry.** Fernau, M.E.; South, D.W.; Guziel, K.A. Argonne National Lab., IL (United States). [1993]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-930433–5: 55. annual American power conference, Chicago, IL (United States), 13-15 Apr 1993). Order Number DE93009969. Source: OSTI; NTIS; INIS; GPO Dep.

Title I of the Clean Air Act Amendments of 1990 requires that regions not in ozone attainment and designated as "severe" take actions to achievement by 2007. In a several-phase study for the US Department of Energy, ANL is investigating the impact and implications of the Title I requirements in the Chicago Metropolitan Area. As part of tie study we examined the potential additional compliance requirements that might be imposed on the electric power industry, after satisfying $O_2$and NO_x requirements specified in Title IV, to achieve attainment in Chicago. Alternative scenarios were examined to show the incremental emission reductions and air quality effects of each action. The Urban Airshed Model (UAM) selected by the US Environmental Protection Agency (EPA) for ozone compliance modeling, was used to assess the effects on air quality. Preliminary results show that, for the episode modeled, compliance with Title TV regulations for utility NO_x emissions did not have much effect on air quality. Consequently, if utilities are the targeted emissions source, it is possible that additional regulations beyond Title IV may be imposed. However, complete removal of utility emissions did not lead to attainment and only improved air quality by 20–25% of the improvement from removing all emissions, pointing out the importance of non-utility sources to the ozone problem in the region. Non-utility sources will be investigated further in another phase of this work.

23350 (LBL–30933) **Modeling of reactive chemical transport of leachates from a utility fly-ash disposal site.** Apps, J.A. (Lawrence Berkeley Lab., CA (United States)); Zhu, M.; Kitanidis, P.K.; Freyberg, D.L.; Ronan, A.D.; Itakagi, S. Lawrence Berkeley Lab., CA (United States); Stanford Univ., CA (United States). Dept. of Civil Engineering. Apr 1991. 6p. Sponsored by Electric Power Research Inst., Palo Alto, CA (United States). DOE Contract AC03-76SF00098. Contract RP2485-15;Contract RP2485-19. (CONF-9107230–2: International symposium on ground water in practice, Nashville, TN (United States), 29 Jul - 2 aug 1991). Order Number DE93010442. Source: OSTI; NTIS; INIS; GPO Dep.

Fly ash from fossil-fuel power plants is commonly slurried and pumped to disposal sites. The utility industry is interested in finding out whether any hazardous constituents might leach from the accumulated fly ash and contaminate ground and surface waters. To evaluate the significance of this problem, a representative site was selected for modeling. FASTCHEM, a computer code developed for the Electric Power Research Institute, was utilized for the simulation of the transport and fate of the fly-ash leachate. The chemical evolution of the leachate was modeled as it migrated along streamtubes defined by the flow model. The modeling predicts that most of the leachate seeps through the dam confining the ash pond. With the exception of ferrous, manganous, sulfate and small amounts of nickel ions, all other dissolved constituents are predicted to discharge at environmentally acceptable concentrations.

23351 (ORNL/FTR–4446) **[Electricity and the environment]: Foreign trip report, May 11–18, 1991.** Wilbanks, T.J. Oak Ridge National Lab., TN (United States). 23 Oct 1992. 25p. Sponsored by USDOE, Washington, DC (United States); Agency for International Development, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93009779. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This travel report describes topics which were discussed at a symposium held in Helsinki Finland concerning energy and the environment. The supply and demand of electricity, electric utility management, and global warming were mainly discussed.

2006 Economic, Industrial, and Business Aspects

Refer also to citation(s) 23351, 23702

2007 Legislation and Regulations

23352 (ANL/EAIS/CP–79050) **The impact of recent visibility litigation on siting/modifying power plants: Survey and analysis.** Loeb, A.P.; Elliott, T.J. Argonne National Lab., IL (United States). 2 Mar 1993. 26p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-930324–1: Symposium on improved technology for fossil power plants: new and retrofit applications, Washington, DC (United States), 1-3 Mar 1993). Order Number DE93009970. Source: OSTI; NTIS; GPO Dep.

Much consideration is being given to the impact of the Clean Air Act Amendments of 1990 (the Amendments) on electric utilities. Certainly, these statutory changes will affect the way utilities do business. But legal pressures can also arise without legislative action. In this paper we call attention to changes in the programs for prevention of significant deterioration (PSD) and visibility of the Clean Air Act (the Act) that are occurring quietly, outside the spotlight of statutory change.

21 NUCLEAR POWER REACTORS AND ASSOCIATED PLANTS

Refer also to citation(s) 23748

23353 (CONF-920906–3) **Trends in advanced reactor development and the role of the IAEA.** Semenov, B. (International Atomic Energy Agency, Vienna (Austria). Dept. of Nuclear Energy and Safety); Dastidar, P.; Kupitz, J.; Cleveland, J.; Goodjohn, A. Oak Ridge National Lab., TN (United States). [1992]. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 15. congress of the World Energy Council (WEC): energy and life; Madrid (Spain); 20-25 Sep 1992. Order Number DE93011866. Source: OSTI; NTIS; INIS; GPO Dep.

This report discusses advanced reactors are being developed for all principal reactor types, i.e. the light and heavy water-cooled reactors, the liquid-metal-cooled reactors and the gas-cooled reactors. Some of these developments are primarily of an evolutionary nature, i.e. they represent improvements in component and system technology, and in construction and operating practices as a result of experience gained with presently operating plants. Other developments are also evolutionary but with some incorporation of innovative features such as providing passive systems for assuring continuous cooling for removal of decay heat from the reactor core. If there is a revival of nuclear power, which may be dictated by ecological and economical factors, advanced reactors now being developed could help to meet the large demand for new plants in developed and developing countries, not only for electricity generation, but also for district heating, desalination and for process heat. The IAEA, as the only global international governmental organization dealing with nuclear power, has promoted international information exchange and international cooperation between all countries with their own advanced nuclear power programmes and has offered assistance to countries with an interest in exploratory or research programmes. In the future the IAEA could play an even more-important role.

23354 (INIS-mf–13502, pp. 1-7) **Safety, a key factor for the future of nuclear energy.** Lewiner, C. (Societe Generale pour les Techniques Nouvelles, SGN, Saint-Quentin-en-Yvelines (France)). European Nuclear Society (ENS), Bern (Switzerland); Czech Nuclear Society, Prague (Czech Republic); Slovak Nuclear Society, Bratislava (Slovakia). Jan 1993. (CONF-921068–: East-West topical meeting: the safe and reliable operation of light water reactor NPP's, Prague (Czechoslovakia), 18-21 Oct 1992). In *Topform '92: the safe and reliable operation of LWR NPPs. Vol. I: Invited plenary session papers.* [235p.] Order Number DE93626240. Source: OSTI; NTIS (US Sales Only); INIS.

The opening address stresses the vital importance of safety for the future development of nuclear power. Comments are given on the way to improve nuclear safety, on national responsibility for a satisfactory level of safety, and on international cooperation in this field. (Z.S.) 1 tab.

23355 (INIS-mf–13502, pp. 8-17) **Safety principles for nuclear power plants.** Vuorinen, A. (Finnish Centre for Radiation and Nuclear Safety (STUK), Helsinki (Finland)). European Nuclear Society (ENS), Bern (Switzerland); Czech Nuclear Society, Prague (Czech Republic); Slovak Nuclear Society, Bratislava (Slovakia). Jan 1993. (CONF-921068–: East-West topical meeting: the safe and reliable operation of light water reactor NPP's, Prague (Czechoslovakia), 18-21 Oct 1992). In *Topform '92: the safe and reliable operation of LWR NPPs. Vol. I: Invited plenary session papers.* [235p.] Order Number DE93626240. Source: OSTI; NTIS (US Sales Only); INIS.

The role and purpose of safety principles for nuclear power plants are discussed. A brief information is presented on safety objectives as given in the INSAG documents. The possible linkage is discussed between the two mentioned elements of nuclear safety and safety culture. Safety culture is a rather new concept and there is more than one interpretation of the definition given by INSAG. The defence in depth is defined by INSAG as a fundamental principle of the safety technology of nuclear power. Discussed is the overall strategy for safety measures, and features of nuclear power plants provided by the defence-in-depth concept. (Z.S.) 7 refs.

23356 (INIS-mf–13502, pp. 61-67) **The training simulator: a powerful tool in the hands of the instructor.** Nyman, S. (Nuclear Training and Safety Center, Nykoeping (Sweden)); Odin, R. European Nuclear Society (ENS), Bern (Switzerland); Czech Nuclear Society, Prague (Czech Republic); Slovak Nuclear Society, Bratislava (Slovakia). Jan 1993. (CONF-921068–: East-West topical meeting: the safe and reliable operation of light water reactor NPP's, Prague (Czechoslovakia), 18-21 Oct 1992). In *Topform '92: the safe and reliable operation of LWR NPPs. Vol. I: Invited plenary session papers.* [235p.] Order Number DE93626240. Source: OSTI; NTIS (US Sales Only); INIS.

The role of the specific-task and full-scale simulators and of the instructor in the personnel training system is discussed. Some tools required in simulator training are listed. (Z.S.).

23357 (INIS-mf–13502, pp. 68-73) **Safety culture in plant operation and maintenance.** Distler, K. (RWE Energie AG, Kraftwerk Biblis (Germany)). European Nuclear Society (ENS), Bern (Switzerland); Czech Nuclear Society, Prague (Czech Republic); Slovak Nuclear Society, Bratislava (Slovakia). Jan 1993. (CONF-921068–: East-West topical meeting: the safe and reliable operation of light water reactor NPP's, Prague (Czechoslovakia), 18-21 Oct 1992). In *Topform '92: the safe and reliable operation of LWR NPPs. Vol. I: Invited plenary session papers.* [235p.] Order Number DE93626240. Source: OSTI; NTIS (US Sales Only); INIS.

Safety culture is used as a synonym for safety consciousness of the operating personnel and safety-oriented management of all activities inside a nuclear power plant. Establishing safety culture in nuclear power plant operation and maintenance calls for the existence of a safe and reliable reactor safety concept, derived from a reactor safety analysis and nuclear power plant operation experience. Competence of plant personnel and safety culture in the operation, maintenance and repair of nuclear power plants are discussed. (Z.S.).

23358 (INIS-mf–13503, pp. 8-11) **Computer aided training in nuclear power engineering at the Gdansk Technical University.** Marecki, J. (Gdansk Univ. (Poland)); Duzinkiewicz, K.; Kosmowski, K.T. European Nuclear Society (ENS), Bern (Switzerland); Czech Nuclear Society, Prague (Czech Republic); Slovak Nuclear Society, Bratislava (Slovakia). Jan 1993. (CONF-921068–: East-West topical meeting: the safe and reliable operation of light water reactor NPP's, Prague (Czechoslovakia), 18-21 Oct 1992). In *Topform '92: the safe and reliable operation of LWR NPPs. Vol. II: Poster papers.* [245p.] Order Number DE93625345. Source: OSTI; NTIS (US Sales Only); INIS.

The Faculty of Electrical Engineering of the Gdansk Technical University has organized post-graduate studies in nuclear power engineering in cooperation with the Institute of Nuclear Research at Swierk since 1973. Post-graduate courses in nuclear power plant construction and design were organized twice. Between 1986 and 1990, prototype software was developed for aiding lectures, self-teaching and knowledge testing in the following fields: (1) dynamics and control of nuclear reactors; (2) simulators of nuclear power plant basic systems (reactor, steam generator, steam turbine, and synchronous generator). (Z.S.) 2 refs.

23359 (INIS-mf–13503, pp. 27-30) **The multi-function simulator.** Remacle, J. (Belgatom SA, Brussels (Belgium)); Billoen, G. Van. European Nuclear Society (ENS), Bern (Switzerland); Czech Nuclear Society, Prague (Czech Republic); Slovak Nuclear Society, Bratislava (Slovakia). Jan 1993. (CONF-921068–: East-West topical meeting: the safe and reliable operation of light water reactor NPP's, Prague (Czechoslovakia), 18-21 Oct 1992). In *Topform '92: the safe and reliable operation of LWR NPPs. Vol. II: Poster papers.* [245p.] Order Number DE93625345. Source: OSTI; NTIS (US Sales Only); INIS.

The need is discussed for simulators in basic principle learning, for specific training on specific functions, for full operation training, for accident analyses as well as the modern tools for modern needs. An optimization is proposed of hardware configuration and software specifications of the equipment to be installed in training centres. (Z.S.).

23360 (INIS-mf–13503, pp. 242-245) **Decision making concept of risk control: integration of decision criteria, top level risk indices and plant performance indices.** Vojnovic, D. (Institut Jozef Stefan, Ljubljana (Yugoslavia)); Mavko, B.; Kozuh, M. European Nuclear Society (ENS), Bern (Switzerland); Czech Nuclear Society, Prague (Czech Republic); Slovak Nuclear Society, Bratislava (Slovakia). Jan 1993. (CONF-921068–: East-West topical meeting: the safe and reliable operation of light water reactor NPP's, Prague (Czechoslovakia), 18-21 Oct 1992). In *Topform '92: the safe and reliable operation of LWR NPPs. Vol. II: Poster papers.* [245p.] Order Number DE93625345. Source: OSTI; NTIS (US Sales Only); INIS.

A support system for risk monitoring and control is suggested. The following concepts of system elements are briefly discussed: risk curve partitioning, the reliability cost function, the multi-objective optimization model, preference assessment, safety/risk indicators, and knowledge based systems. (Z.S.) 2 figs.

23361 (NUREG–0020-Vol.17) **Licensed operating reactors: Status summary report data as of December 31, 1992: Volume 17.** Hartfield, R.A. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Computer and Telecommunications Services. Mar 1993. 341p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). Source: OSTI; NTIS; INIS; GPO.

The Nuclear Regulatory Commission's annual summary of licensed nuclear power reactor data is based primarily on the report of operating data submitted by licensees for each unit for the month of December because that report contains data for the month of December, the year to date (in this case calendar year 1992) and cumulative data, usually from the date of commercial operation. ne data is not independently verified, but various computer checks are made. The report is divided into two sections. The first contains summary highlights and the second contains data on each individual unit in commercial operation Section 1 capacity and availability factors are simple arithmetic averages. Section 2 items in the cumulative column are generally as reported by the licensee and notes as to the use of weighted averages and starting dates other than commercial operation are provided.

2101 Power Reactors, Nonbreeding, Light-Water Moderated, Boiling Water Cooled

Refer also to citation(s) 22881, 23033, 23425, 23528, 23529, 23533, 23551, 23627, 23632, 23642, 23644, 23652, 23653, 23654, 23659, 23664, 23665, 23666, 23668, 23676, 25412

23362 (BNL-NUREG–48415) **Prediction of BWR performance under the influence of Isolation Condenser-using RAMONA-4 code.** Khan, H.J.; Cheng, H.S.; Rohatgi, U.S. Brookhaven National Lab., Upton, NY (United States). [1992]. 20p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-930830–3: National conference and exposition on heat transfer, Atlanta, GA (United States), 8-11 Aug 1993). Order Number DE93007271. Source: OSTI; NTIS; INIS; GPO Dep.

The purpose of the Boiling Water Reactor (BWR) Isolation Condenser (IC) is to passively control the reactor pressure by removing heat from the system. This type of control is expected to reduce the frequency of opening and closing of the Safety Relief Valves (SRV). A comparative analysis is done for a BWR operating with and without the influence of an IC under Main Steam Isolation Valve (MSIV) closure. A regular BWR, with forced flow and high thermal power, has been considered for analysis. In addition, the effect of ICs on the BWR performance is studied for natural convection flow at lower power and modified riser geometry. The IC is coupled to the steam dome for the steam inlet flow and the Reactor Pressure Vessel (RPV) near the feed water entrance for the condensate return flow. Transient calculations are performed using prescribed pressure set points for the SRVs and given time settings for MSIV closure. The effect of the IC on the forced flow is to reduce the rate of pressure rise and thereby decrease the cycling frequency ofthe SRVS. This is the primary objective of any operating IC in a BWR (e.g. Oyster Creek). The response of the reactor thermal and fission power, steam flow rate, collapsed liquid level, and core average void fraction are found to agree with the trend of pressure. The variations in the case of an active IC can be closely related to the creation of a time lag and changes in the cycling frequency of the SRVS. An analysis for natural convection flow in a BWR indicates that the effect of an IC on its transient performance is similar to that for the forced convection system. In this case, the MSIV closure, has resulted in a lower peak pressure due to the magnitude of reduced power. However, the effect of reduced cycling frequency of the SRV due to the IC, and the time lag between the events, are comparable to that for forced convection.

23363 (BNL-NUREG–48448) **Benchmark analysis for the design of piping systems in advanced reactors.** Bezler, P. (Brookhaven National Lab., Upton, NY (United States)); DeGrassi, G.; Braverman, J.; Shounien Hou. Brookhaven National Lab., Upton, NY (United States). [1993]. 6p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-9303103–1: American Society of Mechanical Engineers (ASME) conference on seismic analysis, San Francisco, CA (United States), 22-24 Mar 1993). Order Number DE93008053. Source: OSTI; NTIS; INIS; GPO Dep.

To satisfy the need for the verification of the computer programs and modeling techniques that will be used to perform the final piping analyses for an advanced boding water reactor standard design, three piping benchmark problems were developed. The problems are representative piping systems subjected to representative dynamic loads with solutions developed using the methods being proposed for analysis for the advanced reactor standard design. It will be required that the combined license holders demonstrate that their solutions to these problems are in agreement with the benchmark problem set. A summary description of each problem and some sample results are included.

23364 (INIS-mf–13502, pp. 51-60) **Advanced systems for training in emergency operating procedures.** Ugedo, E. (TECNATOM SA, Madrid (Spain)). European Nuclear Society (ENS), Bern (Switzerland); Czech Nuclear Society, Prague (Czech Republic); Slovak Nuclear Society, Bratislava (Slovakia). Jan 1993. (CONF-921068–: East-West topical meeting: the safe and reliable operation of light water reactor NPP's, Prague (Czechoslovakia), 18-21 Oct 1992). In *Topform '92: the safe and reliable operation of LWR NPPs. Vol. I: Invited plenary session papers.* [235p.] Order Number DE93626240. Source: OSTI; NTIS (US Sales Only); INIS.

The need is emphasized for training operating personnel of nuclear power plants in emergency operating procedures, and the resources are described developed by Tecnatom with a view to increasing the efficiency of instruction provided for all users of the Spanish training center. The solutions provided consist specifically of preparing highly accurate physical models for specific full-scope simulators, and developing a modification of the conventional simulator known as the Interactive Graphics Simulator. (author).

23365 (INIS-mf–13502, pp. 135-146) **NPP evaluation, backfitting and life extension - an engineering viewpoint.** Gonzales, A. (Empresarios Agrupados, Madrid (Spain)). European Nuclear Society (ENS), Bern (Switzerland); Czech Nuclear Society, Prague (Czech Republic); Slovak Nuclear Society, Bratislava (Slovakia). Jan 1993. (CONF-921068–: East-West topical meeting: the safe and reliable operation of light water reactor NPP's, Prague (Czechoslovakia), 18-21 Oct 1992). In *Topform '92: the safe and reliable operation of LWR NPPs. Vol. I: Invited plenary session papers.* [235p.] Order Number DE93626240. Source: OSTI; NTIS (US Sales Only); INIS.

During the decade of the '80s, the owners of the two oldest operating plants in Spain, namely, the Jose Cabrera plant, a Westinghouse PWR, and the Santa Maria de Garona plant, a GE BWR, undertook the following important programmes: (1) a far-reaching Systematic Evaluation Programme for the Jose Cabrera plant consisting in a systematic safety review of the plant design followed by the necessary hardware modifications to upgrade it and to make it comply with current safety criteria, and a Plant Upgrading Programme for the Garona plant focusing on specific topics affecting GE BWR Mark-I type plants of the same vintage; (2) a Remaining Life Management Programme to ensure that the units, after extensive backfitting and high capital investment, would complete their design life, leaving open the option for plant life extension. These two units are today looked upon by the Spanish nuclear industry as the pilot plants for Plant Life Extension programmes for PWRs and BWRs in Spain. The experience learned by the organization of Empresarios Agrupados in the engineering, design and implementation of these programmes is summarized. (Z.S.).

23366 (INIS-mf–13502, pp. 147-158) **Containment backfitting.** Pauli, W. (Sulzer Thermtec Ltd, Winterthur (Switzerland)); Ferroni, F. European Nuclear Society (ENS), Bern (Switzerland); Czech Nuclear Society, Prague (Czech Republic); Slovak Nuclear Society, Bratislava (Slovakia). Jan 1993. (CONF-921068–: East-West topical meeting: the safe and reliable operation of light water reactor NPP's, Prague (Czechoslovakia), 18-21 Oct 1992). In *Topform '92: the safe and reliable operation of LWR NPPs. Vol. I: Invited plenary session papers.* [235p.] Order Number DE93626240. Source: OSTI; NTIS (US Sales Only); INIS.

In nuclear power plants the multi-barrier concept is used to limit the potential release of radioactive fission products to the environment. This so-called defence-in-depth concept consists of three classic barriers, namely the fuel cladding, the reactor coolant pressure boundary, and the containment system. Backfitting measures applied to the containment system are summarized which cope with the loadings beyond design basis. Differences in the design and backfitting philosophy of nuclear power plants (containment venting system, hydrogen mitigation system, containment flooding system) are discussed. (Z.S.) 4 figs.

23367 (INIS-mf–13502, pp. 171-182) **Advances in instrumentation and data processing.** Berggren, J. (Vattenfall Energiesystem AB, Stockholm (Sweden)); Eriksson, T.; Waessman, P.-O. European Nuclear Society (ENS), Bern (Switzerland); Czech Nuclear Society, Prague (Czech Republic); Slovak Nuclear Society, Bratislava (Slovakia). Jan 1993. (CONF-921068–: East-West topical meeting: the safe and reliable operation of light water reactor NPP's, Prague (Czechoslovakia), 18-21 Oct 1992). In *Topform '92: the safe and reliable operation of LWR NPPs. Vol. I: Invited plenary session papers.* [235p.] Order Number DE93626240. Source: OSTI; NTIS (US Sales Only); INIS.

Some examples are presented of upgrading recently performed at Swedish nuclear power plants; the examples shall serve as a background for discussion. To illustrate possible advances, some examples are also given of future techniques which are currently being studied. The following areas are covered: in-core instrumentation; improvement of essential systems, in particular to allow for operation closer to the margin set; additional instrumentation for better handling of particular situations like shutdown and loss of coolant events; instrumentation for plant aging and fault assessment. In all areas a trend can be seen to put the emphasis on data processing. (Z.S.) 7 refs.

23368 (INIS-mf–13503, pp. 160-165) **Motor-operated valve analysis program to address the design basis review requirements of the US NRC's Generic Letter 89-10.** Recinella, M. (Westinghouse Energy Systems International, Brussels (Belgium)); Isaac, F.; Matty, T. European Nuclear Society (ENS), Bern (Switzerland); Czech Nuclear Society, Prague (Czech Republic); Slovak Nuclear Society, Bratislava (Slovakia). Jan 1993. (CONF-921068–: East-West topical meeting: the safe and reliable operation of light water reactor NPP's, Prague (Czechoslovakia), 18-21 Oct 1992). In *Topform '92: the safe and reliable operation of LWR NPPs. Vol. II: Poster papers.* [245p.] Order Number DE93625345. Source: OSTI; NTIS (US Sales Only); INIS.

The elements and the methodologies are described used by Westinghouse to address the Motor-Operated Valve (MOV) Design Basis Review requirements of the NRC Generic Letter 89-10, namely, data collection, thrust and torque calculation, valve weak link analysis, motor operator evaluation and MOV recommended torque switch setting. (Z.S.) 7 refs.

23369 (JAERI-M–93-006) **Experimental data report for Test TS-2 reactivity initiated accident test in NSRR with pre-irradiated BWR fuel rod.** Nakamura, Takehiko (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Tokai Research Establishment); Yoshinaga, Makio; Sobajima, Makoto; Fujishiro, Toshio; Kobayashi, Shinsho; Yamahara, Takeshi; Sukegawa, Tomohide; Kikuchi, Teruo. Japan Atomic Energy Research Inst., Tokyo (Japan). Feb 1993. 107p. Order Number DE93797596. Source: OSTI; NTIS; INIS.

This report presents experimental data for Test TS-2 which was the second test in a series of Reactivity Initiated Accident (RIA) condition test using pre-irradiated BWR fuel rods, performed at the Nuclear Safety Research Reactor (NSRR) in February, 1990. Test fuel rod used in the Test TS-2 was a short sized BWR (7x7) type rod which was fabricated from a commercial rod irradiated at Tsuruga Unit 1 power reactor. The fuel had an initial enrichment of

2.79% and a burnup of 21.3Gwd/tU (bundle average). A pulse irradiation of the test fuel rod was performed under a cooling condition of stagnant water at atmospheric pressure and at ambient temperature which simulated a BWR's cold start-up RIA event. The energy deposition of the fuel rod in this test was evaluated to be 72±5cal/g·fuel (66±5cal/g·fuel in peak fuel enthalpy) and no fuel failure was observed. Descriptions on test conditions, test procedures, transient behavior of the test rod during the pulse irradiation, and, results of pre and post pulse irradiation examinations are described in this report. (author).

23370 (NUREG/CR–5672-Vol.3) **Characteristics of low-level radioactive decontamination waste: Annual report for Fiscal Year 1992: Volume 3.** Akers, D.W. (EG and G Idaho, Inc., Idaho Falls, ID (United States)); McConnell, J.W. Jr.; Morcos, N. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Regulatory Applications; EG and G Idaho, Inc., Idaho Falls, ID (United States). Feb 1993. 66p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC07-76ID01570. (EGG–2635-Vol.3). Source: OSTI; NTIS; INIS; GPO.

This document addresses the work performed during fiscal year 1992 at the Idaho National Engineering Laboratory by the Low-Level Radioactive Waste – Decontamination Waste Program (FIN A6359), which is funded by the US Nuclear Regulatory Commission. The program evaluates the physical stability and leachability of solidified waste streams generated in the decontamination process of primary coolant systems in operating nuclear power stations. The data in this document include the chemical composition and characterization of waste streams from Peach Bottom Atomic Power Station Unit 3 and from Nine Mile Point Nuclear Plant Unit 1. The results of compressive strength testing on immersed and unimmersed solidified waste-form specimens from peach Bottom, and the results of leachate analysis are addressed. Cumulative fractional release rates and leachability indexes of those specimens were calculated and are included in this report.

23371 (NUREG/CR–5999) **Interim fatigue design curves for carbon, low-alloy, and austenitic stainless steels in LWR environments.** Majumdar, S. (Argonne National Lab., IL (United States)); Chopra, O.K.; Shack, W.J. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Engineering; Argonne National Lab., IL (United States). Apr 1993. 31p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract W-31109-ENG-38. (ANL–93/3). Source: OSTI; NTIS; INIS; GPO.

Existing data in the literature on fatigue of carbon, low-alloy, and austenitic stainless steels in LWR environments are reviewed. It is found that both temperature and dissolved-oxygen concentration in water significantly affect fatigue life. At the very low dissolved-oxygen levels characteristic of pressurized water reactors and boiling water reactors with hydrogen-water chemistry. environmental effects on fatigue life are modest. However, at higher dissolved-oxygen levels (≥100 ppB), significant reductions in fatigue life can occur. The susceptibility of carbon and low-alloy steels to reduced fatigue life is strongly related to sulfur concentration. Although the fatigue lives of austenitic stainless steels may be reduced, the reductions are much smaller than those observed in high-sulfur carbon and low-alloy steels. In oxygenated water, fatigue life depends strongly on strain rate. Interim fatigue design curves are proposed that take Into account temperature, dissolved-oxygen level in the water, the sulfur level in the steel, and strain rate. Design curves for carbon and low-alloy steels for lives up to 10^6 cycles are also proposed.

23372 (PSI–93-01) **Analyses of reactivity insertion accidents in the Muehleberg boiling water reactor.** Belblidia, L.A. (Paul Scherrer Inst. (PSI), Villigen (Switzerland)); Kallfelz, J.M.; Knoglinger, E. Paul Scherrer Inst. (PSI), Villigen (Switzerland). Jan 1993. [54p.] (STARS–8A.). Order Number DE93626248. Source: OSTI; NTIS; INIS.

In the framework of STARS (simulation models for the transient analysis of the reactors in Switzerland) project, two reactivity insertion accidents in the Muehleberg boiling water reactor at HZP were analyzed. Beyond-design-basis conditions were considered for both accidents, as required by the definition of the task. The first case is the rod-drop accident (RDA), caused by the drop of the highest worth control rod out of the core from a fully inserted position at its maximum velocity. The resulting large reactivity insertion leads to a rapid power surge (terminated by the Doppler feedback) and to large increases in fuel temperatures and enthalpy. The second case is the uncontrolled central rod withdrawal without scram. This is a relatively slow transient compared to the RDA, and when equilibrium is reached the void reactivity predominates in the effects compensating for worth of the withdrawn rod. The analyses are performed with the best-estimate BWR code RAMONA-3B, using a 1/8-th core model, with hot zero power initial conditions. In all cases considered the results for the maximum fuel enthalpy indicate ample margins to the 280 cal/g safety limit. (author) 46 figs., 5 tabs., 37 refs.

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Refer also to citation(s) 22881, 23033, 23364, 23365, 23366, 23367, 23371, 23527, 23529, 23534, 23551, 23625, 23626, 23627, 23628, 23629, 23638, 23643, 23644, 23649, 23651, 23652, 23653, 23654, 23655, 23656, 23657, 23658, 23661, 23664, 23666, 23668, 23670, 23673, 23676, 24091, 25412

23373 (CEA-CONF–11278) **Calculational and experimental investigations of void effect. A new model for leakage treatment of heterogeneous assemblies.** Benoist, P. (CEA Centre d'Etudes de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Mecanique et de Technologie); Petrovic, I.; Mondot, J. CEA Centre d'Etudes de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Mecanique et de Technologie. 1993. [15p.] (CONF-930404–: International topical meeting on mathematical methods and supercomputing in nuclear applications (M&C+SNA '93), Karlsruhe (Germany), 19-23 Apr 1993). Order Number DE93626259. Source: OSTI; NTIS (US Sales Only); INIS.

The growing interest in safety problems had led physicists to try to increase their knowledge of the neutron leakage phenomenon, both by calculation and by experiment. The flux calculation in a heterogeneous assembly is frequently performed by collision probability method. On the contrary, neutron leakage is calculated for a flux-weighted homogenized assembly, which is a good approximation for a non-voided assembly (PWR in normal conditions). In a LOCA situation, the assembly may contain void zones, and this model for leakage calculation may become insufficient. We propose here a new theoretical model, taking into account the effect of heterogeneity of the assembly on neutron leakage, and which was implemented as TIBERE procedure in the multigroup transport assembly code APPOLO-2. One of the advantages of this new model is to allow a perfectly consistent definition of cell reaction and cell leakage rates used in the equivalence procedure. As well as this theoretical work was made, an experimental program concerning this phenomenon was performed as a part of EPICURE experiment. Comparisons of experimental and calculational results point out better agreement of the new model with the measurements.

23374 (CEA-CONF–11280) **Implicit approximate Riemann solver for two fluid two phase flow models.** Raymond, P.; Toumi, I.; Kumbaro, A. CEA Centre d'Etudes de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Mecanique et de Technologie. 1993. [17p.] (CONF-9305191–: 3. Nuclear simulation Symposium and mathematical modeling workshop, Schliersee (Germany), 17-19 May 1993). Order Number DE93626260. Source: OSTI; NTIS (US Sales Only); INIS.

This paper describes new numerical methods developed for numerical treatment of two phase flow models with two velocity fields now widely used in nuclear engineering for design or safety calculations. These finite volumes numerical methods are based on use of Approximate Riemann Solver's concepts in order to define convective flux vs mean cell quantities. The first part of this paper describes the numerical method for a 3-D drift flux model and extensions performed to make the numerical scheme implicit and to have fast running calculations of steady states. Such a scheme is implemented in the FLICA-4 computer code devoted to 3-D steady state and transient core computations. Results are presented, obtained for a steady state flow with rod bow effect evaluation and for

a Steam Line Break calculation where the 3-D core thermal computation was coupled with 3-D kinetic and thermal-hydraulic transient calculations for the four loops of a PWR. The second part of the paper details the development of an equivalent numerical method based on an approximate Riemann Solver for a two fluid model with two momentum balance equations for the liquid and the gas phases. The main difficulty for these models is due to the existence of differential modelling terms such as added mass effects or interfacial pressure terms which make the model hyperbolic. These terms does not permit to write the balance equations system in a conservative form, and the classical theory for discontinuity propagation for nonlinear systems cannot be applied. Meanwhile, the use of non-conservative products theory allows the study of discontinuity propagation for a non conservative model and this will permit the construction of a numerical scheme for two fluid two phase flow model. These different points are detailed in that section which are illustrated by various significant numerical tests computed with a 1-D model.

23375 (CEA-CONF–11281) **Electrochemical measurements in PWR steam generators to follow crevice chemistry.** Feron, D. (CEA Centre de La Hague, 50 - Cherbourg (France)). CEA Centre d'Etudes de Fontenay-aux-Roses, 92 (France). Service de la Corrosion, d'Electrochimie et Chimie des Fluides. 1991. [6p.] (CONF-9104345–: 1991 JAIF international conference on water chemistry in nuclear power plants, Fukui (Japan), 22-25 Apr 1991). Order Number DE93626261. Source: OSTI; NTIS (US Sales Only); INIS.

In PWR steam generator crevices, the evolution of chemistry is important for the understanding of corrosion phenomena. Electrochemical measurements have been performed in high temperature simulated crevice environments in order to follow hideout processes and remedial actions (on-line addition of boric acid). Reported tests have been conducted with model boilers of AJAX facilities. Eccentric and concentric tube support plate crevices have been instrumented with platinum electrodes. Electrochemical measurements have been collected when model boiler was under nominal conditions (primary temperature: 335 deg C, secondary temperature: 280 deg C). They include Electrochemical Impedance Spectroscopy (EIS) and potential measurements: with EIS, sodium and boric acid hideouts have been detected and followed. Potential measurements have been performed in an attempt to measure crevice PH evolution.

23376 (CEA-CONF–11283) **Solid-liquid equilibrium of the system boric oxide-lithium oxide-water at 300 deg C.** Lambert, I. CEA Centre d'Etudes de Fontenay-aux-Roses, 92 (France). Service de la Corrosion, d'Electrochimie et Chimie des Fluides. 1991. [10p.] (CONF-9108114–: 2. international symposium on chemistry in high temperature water, Provo, UT (United States), 19-22 Aug 1991). Order Number DE93626263. Source: OSTI; NTIS (US Sales Only); INIS.

The solid-liquid equilibrium diagram of the system B_2O_3-Li_2O-H_2O is, up to now, known only in the temperature range 25 to 100 deg C. We determined the solubility isotherm in the system B_2O_3-Li_2O-H_2O at 300 deg C for B_2O_3/Li_2O mole ratio from 1 to 600 in solution. The values of saturation concentrations make it possible to predict the behaviour of a possible leak between primary and secondary circuit of nuclear reactors: the results show that at the beginning of the cycle, when the ratio B_2O_3/Li_2O is high, borate precipitation induced by boiling through the leak may lead to occlusion, and that this borate may dissolve when the ratio B_2O_3/Li_2O decreases during the course of the cycle. The solid phases identified by X-Ray diffraction were B_2O_3, $Li_2B_{10}O_{16}H_2O$, $Li_4B_{10}O_{17}$, $Li_2B_4O_7$, $Li_3B_5O_8(OH)_2$, $LiBO_2$. The existence of $Li_3B_5O_8(OH)_2$ was not reported in low temperatures equilibrium systems.

23377 (CEA-CONF–11284) **Impedance study of oxide films formed on zircaloy 4 in high temperature pressurized water.** Bataillon, C.; Brunet, S. CEA Centre d'Etudes de Fontenay-aux-Roses, 92 (France). Service de la Corrosion, d'Electrochimie et Chimie des Fluides. 1991. [6p.] (CONF-9110490–: EUROCORR'91, Budapest (Hungary), 21-25 Oct 1991). Order Number DE93626264. Source: OSTI; NTIS (US Sales Only); INIS.

Improvement of the corrosion resistance of fuel claddings in Pressurized Water Reactors (PWR) has received increasing interest over last decade. Moreover, few data concerning dielectric properties, chemical composition and structure of oxide films are nowadays available. The purpose of this paper is to analyze the chemical and physical features of oxide films formed on Zircaloy 4 in conditions similar to PWR exposure and to connect modifications of these features to the change in the kinetic of the oxidation process.

23378 (CEA-CONF–11285) **Stress corrosion cracking behaviour of alloys 600 and 690 in water and caustic solutions.** Helie, M.; Blanchet, J.; Santarini, G. CEA Centre d'Etudes de Fontenay-aux-Roses, 92 (France). Service de la Corrosion, d'Electrochimie et Chimie des Fluides. 1991. [6p.] (CONF-9110490–: EUROCORR'91, Budapest (Hungary), 21-25 Oct 1991). Order Number DE93626265. Source: OSTI; NTIS (US Sales Only); INIS.

For many industries, corrosion damages and particularly those due to Stress Corrosion Cracking (SCC) remain one of the most difficult problems to fight as well as to understand for the researcher. The Nuclear Energy Industry is no exception to that rule and the Commissariat a l'Energie Atomique has been studying the stress corrosion cracking phenomenon of nuclear alloys for more than 30 years, phenomenon which is still the subject of a great number of studies among the Nuclear Industrialists. The aim of the following paper is to briefly summarize some results obtained in a study of the SCC behaviour of Alloys 600 and 690 in mediums such as primary water and caustic solution (simulating local conditions of the secondary side) involving, in the case of the Constant Elongation Rate Tests in primary medium, the influence of the temperature, surface state, thermal treatment and strain rate.

23379 (CEA-CONF–11286) **Solubility of cobalt in primary circuit solutions.** Lambert, I. (CEA Centre d'Etudes de Fontenay-aux-Roses, 92 (France). Service de la Corrosion, d'Electrochimie et Chimie des Fluides); Joyer, F. CEA Centre d'Etudes de Fontenay-aux-Roses, 92 (France). Service de la Corrosion, d'Electrochimie et Chimie des Fluides. 1992. [4p.] (CONF-921012–: 6. international conference on water chemistry of nuclear reactor systems, Bournemouth (United Kingdom), 12-15 Oct 1992). Order Number DE93626266. Source: OSTI; NTIS (US Sales Only); INIS.

The solubility of cobalt ferrite ($CoFe_2O_4$) was measured in PWR primary circuit conditions, in the temperature range 250-350 deg C, and the results were compared with the ones obtained on magnetite and nickel ferrite. As in the former cases, it was found that, in the prevailing primary circuit conditions, the solubility of the cobalt ferrite was minimum at temperatures around 300 deg C, for cobalt as well as for iron. The equilibrium iron concentration is significantly lower than in the case of magnetite. The results are discussed in relation with the POTHY code, based only on thermodynamic laws and data, used for the prediction of the primary circuit chemistry.

23380 (CEA-CONF–11287) **Transport of lead in secondary systems of PWR plants: laboratory and plant investigations.** Feron, D. (CEA Centre de La Hague, 50 - Cherbourg (France)); Rocher, A.; Nordmann, F. CEA Centre d'Etudes de Fontenay-aux-Roses, 92 (France). Service de la Corrosion, d'Electrochimie et Chimie des Fluides. 1992. [7p.] (CONF-921012–: 6. international conference on water chemistry of nuclear reactor systems, Bournemouth (United Kingdom), 12-15 Oct 1992). Order Number DE93626267. Source: OSTI; NTIS (US Sales Only); INIS.

Both in France and abroad, abnormally high lead concentrations have been found in the deposits on certain steam generator tubes subject to combined inter and transgranular corrosion on the secondary side. Many potential sources of lead have been identified in PWR steam-water system, mainly at the turbine level. Tests on a loop (ORION) have shown that lead (as Pb or PbO) can transport from the condenser to the steam generator and that the contaminant mainly concentrates in flow restricted areas of steam generators.

23381 (CONF-930702–12) **Potential change in flaw geometry during pressurized-thermal-shock transients.** Shum, D.K.M.; Bryson, J.W.; Merkle, J.G.; Keeney-Walker, J.; Dickson, T.L.; Bass, B.R. Oak Ridge National Lab., TN (United States). [1993]. 42p.

Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC05-84OR21400. From Pressure vessel and piping conference; Denver, CO (United States); 25-29 Jul 1993. Order Number DE93009709. Source: OSTI; NTIS; INIS; GPO Dep.

This study presents preliminary estimates on the potential change in flaw geometry of an initially shallow, axially oriented, inner-surface finite-length flaw in a PWR-RPV during the course of a postulated PTS transient. Specifically, the question being addressed is whether a shallow, axially oriented, finite-length surface flaw would tend to elongate in the axial direction and/or deepen into the wall of the vessel during the transient. In the first part of the study, estimates are obtained based on the assumptions of linear-elastic material response. The thermo-elastic properties of the cladding and base material are explicitly considered. The flaw geometry corresponds to a family of modified-elliptical flaws characterized by the flaw's half-length to maximum depth (aspect ratio). Requirements for numerical convergence of the finite element results are examined. In the second part of the study, the sensitivity of the numerical results and conclusions obtained in the first part of the study to the following three analysis assumptions are evaluated: (1) Reference flaw geometry along the entire crack front and especially within the cladding region; (2) Linear-elastic versus elastic-plastic description of material response; (3) Base-material-only vs bi-material cladding-base vessel-model assumption.

23382 (EGG-RAAM–10669) **Extensions to the SCDAP/RELAP5 code for the modeling of debris oxidation and materials interactions preliminary design report.** Siefken, L.J.; Davis, K.L. EG and G Idaho, Inc., Idaho Falls, ID (United States). Feb 1993. 27p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC07-76ID01570. Order Number DE93013699. Source: OSTI; NTIS; INIS; GPO Dep.

Preliminary designs are proposed for extending the SCDAP/RELAP5 code so that it models (a) the oxidation of slumping fuel rod material and cohesive and porous debris and (b) the interaction of PWR control rod materials with the other materials in a reactor core. These extensions have the purpose of improving the code's calculation of the damage progression and hydrogen production that takes place during the early phase of a severe accident.

23383 (INIS-mf–13502, pp. 28-37) **Safety trends and design progress of future French-German Pressurized Water Reactor.** Ruess, F. (Nuclear Power International SNC, Paris (France)). European Nuclear Society (ENS), Bern (Switzerland); Czech Nuclear Society, Prague (Czech Republic); Slovak Nuclear Society, Bratislava (Slovakia). Jan 1993. (CONF-921068–: East-West topical meeting: the safe and reliable operation of light water reactor NPP's, Prague (Czechoslovakia), 18-21 Oct 1992). In *Topform '92: the safe and reliable operation of LWR NPPs. Vol. I: Invited plenary session papers.* [235p.] Order Number DE93626240. Source: OSTI; NTIS (US Sales Only); INIS.

Within the cooperation between Framatome SA and Siemens AG in the field of Pressurized Water Reactors, Nuclear Power International (NPI) was established in 1989. The basic objectives of this joint venture are the marketing of PWRs and the development of a common French-German technology for the next generation of PWRs. The organization and the time schedule of the development work are described. Basic safety trends are indicated and the main technical features of this reactor (safety systems on the primary side, secondary-side heat-removal systems, reactor building and containment, instrumentation and control) are outlined, as they are proposed today to the French and German utilities by NPI, Framatome and Siemens. Tentative safety probabilistic target: no family of events should lead to a core melt frequency higher than 10^{-7}/year and the overall core melt frequency should not be higher than 10^{-6}/year. The overall strategy for severe accidents is defined in such a way that the probability of high pressure core melt scenarios should be reduced by providing a highly reliable secondary-side heat removal and safety-grade primary bleed functions to a level significantly below 10^{-7}/year. (Z.S.) 6 figs.

23384 (INIS-mf–13502, pp. 38-50) **Staff training and education: Eastern point of view.** Dugovic, M. (Vyskumny Ustav Jadrovych Elektrarni, Trnava (Czechoslovakia)). European Nuclear Society (ENS), Bern (Switzerland); Czech Nuclear Society, Prague (Czech Republic); Slovak Nuclear Society, Bratislava (Slovakia). Jan 1993. (CONF-921068–: East-West topical meeting: the safe and reliable operation of light water reactor NPP's, Prague (Czechoslovakia), 18-21 Oct 1992). In *Topform '92: the safe and reliable operation of LWR NPPs. Vol. I: Invited plenary session papers.* [235p.] Order Number DE93626240. Source: OSTI; NTIS (US Sales Only); INIS.

The establishment of a unified system of nuclear power plant personnel training started in Czechoslovakia in 1979. Basic phases of the development of plant personnel training are described and an evaluation of the existing system presented. The use of a full-scale simulator in training is described and the basic conceptual design features given. The present trends in the field of personnel training are described. (Z.S.) 8 figs.

23385 (INIS-mf–13502, pp. 74-78) **Safety culture in the operation of nuclear power plants in CSFR.** Suchomel, J. (Vyskumny Ustav Jadrovych Elektrarni, Trnava (Czechoslovakia)). European Nuclear Society (ENS), Bern (Switzerland); Czech Nuclear Society, Prague (Czech Republic); Slovak Nuclear Society, Bratislava (Slovakia). Jan 1993. (CONF-921068–: East-West topical meeting: the safe and reliable operation of light water reactor NPP's, Prague (Czechoslovakia), 18-21 Oct 1992). In *Topform '92: the safe and reliable operation of LWR NPPs. Vol. I: Invited plenary session papers.* [235p.] Order Number DE93626240. Source: OSTI; NTIS (US Sales Only); INIS.

Three aspects are discussed of safety culture in the operation of nuclear power plants in Czechoslovakia, namely, the rewards and sanctions, the individual attitudes and procedures, and plant safety experience as defined in Sections 3.2.4, 4.2.2.2 and 4.2.2.3, respectively, of the IAEA report on Safety Culture by the INSAG, 1991. (Z.S.).

23386 (INIS-mf–13502, pp. 79-80) **Introductory statement for the panel discussion 'Safety Culture in Plant Operation and Maintenance'.** Vamos, G. (Paksi Atomeroemue Vallalat, Paks (Hungary)). European Nuclear Society (ENS), Bern (Switzerland); Czech Nuclear Society, Prague (Czech Republic); Slovak Nuclear Society, Bratislava (Slovakia). Jan 1993. (CONF-921068–: East-West topical meeting: the safe and reliable operation of light water reactor NPP's, Prague (Czechoslovakia), 18-21 Oct 1992). In *Topform '92: the safe and reliable operation of LWR NPPs. Vol. I: Invited plenary session papers.* [235p.] Order Number DE93626240. Source: OSTI; NTIS (US Sales Only); INIS.

The problem areas are dealt with of the Paks nuclear power plant operational practice from the point of view of safety culture. (Z.S.).

23387 (INIS-mf–13502, pp. 81-92) **Maintenance organization and outage planning in NPPs.** Nikolayev, V. (Russian Federation Nuclear Society, Moscow (Russian Federation)). European Nuclear Society (ENS), Bern (Switzerland); Czech Nuclear Society, Prague (Czech Republic); Slovak Nuclear Society, Bratislava (Slovakia). Jan 1993. (CONF-921068–: East-West topical meeting: the safe and reliable operation of light water reactor NPP's, Prague (Czechoslovakia), 18-21 Oct 1992). In *Topform '92: the safe and reliable operation of LWR NPPs. Vol. I: Invited plenary session papers.* [235p.] Order Number DE93626240. Source: OSTI; NTIS (US Sales Only); INIS.

The Nuclear Society of the Russian Federation is responsible for all commercial electric power generation in nuclear power plants in Russia (ie., 9 nuclear power plants), and for managing several maintenance enterprises and other technical support organizations. The current status is presented of the maintenance policy and the organization of the maintenance. The impact of maintenance on the reliability of the nuclear power plant systems, and the methods for developing maintenance improvement practices are described. (Z.S.) 4 figs.

23388 (INIS-mf–13502, pp. 93-106) **Preparing and organizing inspection and maintenance.** Vuorenmaa, A. (Imatran Voima Oy, Loviisa (Finland). Loviisa Power Plant). European Nuclear Society (ENS), Bern (Switzerland); Czech Nuclear Society, Prague (Czech Republic); Slovak Nuclear Society, Bratislava (Slovakia). Jan 1993. (CONF-921068–: East-West topical meeting: the safe and reliable operation of light water reactor NPP's, Prague (Czechoslovakia), 18-21 Oct 1992). In *Topform '92: the safe and*

reliable operation of LWR NPPs. Vol. I: Invited plenary session papers. [235p.] Order Number DE93626240. Source: OSTI; NTIS (US Sales Only); INIS.

The philosophy and goals of maintenance are discussed. The main principles in organizing the maintenance of the Loviisa power plant are: the people responsible for maintenance during operation are also responsible for maintenance during outages; outside contractors are used for the peak loads during outages but the planning and monitoring of outages is the responsibility of the plant personnel. Technically skilled and highly motivated personnel is the most important prerequisite of success. Loviisa has for several years very successfully utilized two different types of salary bonus system. The reloading outage bonus system gives more money per hour during the outage and an additional increase for all plant people participating in the outage work, if the duration of the outage is shorter than planned. The amount of the extra bonus depends on the final duration of the outage. The operation and maintenance of the Loviisa plant is based on quality assurance, operation and maintenance procedures. The annual and long-term plan of actions are controlled by regular planning meetings which utilize all reports produced by the maintenance groups. The technical outage report contains all technical information gathered during the outages according to the preventive maintenance and in-service inspection programs. The condition monitoring programs of the plant components were developed by the Research Laboratories of Imatran Voima and financed by the plant. (Z.S.) 9 figs., 5 refs.

23389 (INIS-mf–13502, pp. 107-118) **Steam generator replacement - European experience.** Bacot, J. (EdF CIG, Marseille (France)). European Nuclear Society (ENS), Bern (Switzerland); Czech Nuclear Society, Prague (Czech Republic); Slovak Nuclear Society, Bratislava (Slovakia). Jan 1993. (CONF-921068–: East-West topical meeting: the safe and reliable operation of light water reactor NPP's, Prague (Czechoslovakia), 18-21 Oct 1992). In *Topform '92: the safe and reliable operation of LWR NPPs. Vol. I: Invited plenary session papers.* [235p.] Order Number DE93626240. Source: OSTI; NTIS (US Sales Only); INIS.

The susceptibility of steam generator tube bundles to corrosion is a major concern of operators of PWR nuclear power plants. Since 1980 they have been led to undertake several steam generator replacement operations in the US and in Europe: since Surry 2 in 1980, 13 operations were performed including Obrigheim (1983), Ringhals 2 (1989), Dampierre 1 (1990) in Europe; almost the same number of operations are planned for the period up to 1995, including Bugey 5 (1993), Doel 3 (1993), Ringhals 3 (1995), Tihange 1 (1995), Gravelines 1 (1994 or 1995), Asco 1 or Almaraz (1995) for Europe. A brief description of each project and the main European projects is given. Replacement of the entire steam generator in one piece appears to be the dominant technology in European projects. The current trend is to use mechanical cutting techniques for primary pipe cutting, and the narrow-gap welding technique. The method of fitting up progressed from the two, three or four-cut processes when a cut change is not required. The tube material used is thermally-treated Inconel 690 or Incoloy 800. The major changes in the steam generator design are summarized. (Z.S.) 6 refs.

23390 (INIS-mf–13502, pp. 119-123) **Replacement of process computer during full power operation.** Kroon, J. (KCB, Borssele (Netherlands)); Loos, C. European Nuclear Society (ENS), Bern (Switzerland); Czech Nuclear Society, Prague (Czech Republic); Slovak Nuclear Society, Bratislava (Slovakia). Jan 1993. (CONF-921068–: East-West topical meeting: the safe and reliable operation of light water reactor NPP's, Prague (Czechoslovakia), 18-21 Oct 1992). In *Topform '92: the safe and reliable operation of LWR NPPs. Vol. I: Invited plenary session papers.* [235p.] Order Number DE93626240. Source: OSTI; NTIS (US Sales Only); INIS.

The Borssele nuclear power plant was delivered in 1973 with a Siemens 306 process computer. 3000 logical signals and 400 analogs were connected to the computer. In 1984 the decision was made to replace the system with a new Process Presentation System. The new system was installed in 1988 and 1989. It originally consisted of three levels: (1) the Data Acquisition level equipped with Cegelec T20 controllers; (2) a Bull SPS-5 Data Base processor and Man-Machine Interface controller, with software based on Cegelec T20-Centralog design; (3) a concurrent 3680 Applications Processor. Levels 2 and 3 consist of two redundant trains with fully automatic fail-safe software. The system has a capacity of handling 1200 analog signals and 6000 logical signals. Soon after delivery of the system, the projected reserve capacity was already fully charged. In 1992 a fourth level was introduced. The projected backfitting projects will cause a demand for connection of additional signals. The increase in data handling capacity requires the replacement of the level 2 computers. Due to the limited amount of functions of the old process computerm the exchange can be done during normal power operation. (Z.S.).

23391 (INIS-mf–13502, pp. 124-134) **Upgrading requirements.** Govaerts, P. (AV Nuclear, Bruxelles (Belgium)); Dresse, H.; Roch, M. European Nuclear Society (ENS), Bern (Switzerland); Czech Nuclear Society, Prague (Czech Republic); Slovak Nuclear Society, Bratislava (Slovakia). Jan 1993. (CONF-921068–: East-West topical meeting: the safe and reliable operation of light water reactor NPP's, Prague (Czechoslovakia), 18-21 Oct 1992). In *Topform '92: the safe and reliable operation of LWR NPPs. Vol. I: Invited plenary session papers.* [235p.] Order Number DE93626240. Source: OSTI; NTIS (US Sales Only); INIS.

Belgium was the first country in the world to have required in the operating license of each nuclear power plant, a safety reassessment on a periodical basis (10, 20, 30...years) after the plant has reached its nominal power. The utility and the safety authority jointly proceed with a comparative examination of the design, construction, operating rules and procedures of the existing plant with respect to the current rules and practices in use in the U.S. and in the European Community at the time of the review. As a technical support to the competent authorities, supervising nuclear safety, AV Nuclear is in charge of that examination and acts as the regulatory body. The report is presented to the ministries supervising nuclear safety and to the Belgian Nuclear Safety Commission. After their approval the report is referenced in the operating licenses of the plant and the utility must comply with it. Described are the types of review during plant operation, the objectives of periodic safety reassessments, and the safety reassessment of the units Doel 1, 2 and 3 and Tihange 1 and 2. The first safety reassessments performed for the Belgian plants resulted in a very extensive re-analysis of the safety of the plants, and the adoption of consistent modifications. (Z.S.) 3 refs.

23392 (INIS-mf–13502, pp. 159-170) **Innovation of safety systems of the V-1 Bohunice plant.** Rohar, S. (Vyskumny Ustav Jadrovych Elektrarni, Trnava (Czechoslovakia)). European Nuclear Society (ENS), Bern (Switzerland); Czech Nuclear Society, Prague (Czech Republic); Slovak Nuclear Society, Bratislava (Slovakia). Jan 1993. (CONF-921068–: East-West topical meeting: the safe and reliable operation of light water reactor NPP's, Prague (Czechoslovakia), 18-21 Oct 1992). In *Topform '92: the safe and reliable operation of LWR NPPs. Vol. I: Invited plenary session papers.* [235p.] Order Number DE93626240. Source: OSTI; NTIS (US Sales Only); INIS.

In 1990 several reviews were carried out of the operational safety of the V-1 nuclear power plant at Jaslovske Bohunice. As a result, short- and long-term measures for upgrading the safety of the units were recommended. The extent of the ongoing backfitting programme, to be completed by the end of 1992, is assessed to cost approximately 15% of the original initial investment costs for the construction of the V-1 plant. The objectives of the safety system innovation programme (active and passive emergency core cooling systems, confinement system for accident localization, superemergency feedwater of steam generators, emergency on-site sources of power supply) are described. The design reliability of the ECCS expressed in terms of the probability of failure is specified at the maximum level of 10^{-3} per reactor-year which is the level used in the design of western nuclear power plants. The strategic intention of the whole backfitting of the V-1 plant is to obtain the probability of severe core damage lower than 10^{-4} per reactor-year. (Z.S.) 2 figs., 1 ref.

23393 (INIS-mf–13502, pp. 198-210) **SIPA-SWORD: a 'configurable' simulator for safety.** Guinard, E. (EdF, Paris (France). Nuclear and Fossil Generation Division); Houdayer, G.; Poizat, M.F. European Nuclear Society (ENS), Bern (Switzerland); Czech Nuclear Society, Prague (Czech Republic); Slovak Nuclear Society,

Bratislava (Slovakia). Jan 1993. (CONF-921068–: East-West topical meeting: the safe and reliable operation of light water reactor NPP's, Prague (Czechoslovakia), 18-21 Oct 1992). In *Topform '92: the safe and reliable operation of LWR NPPs. Vol. I: Invited plenary session papers.* [235p.] Order Number DE93626240. Source: OSTI; NTIS (US Sales Only); INIS.

SIPA means 'Post Accident Simulator'; it attempts to account for the dynamic behavior of a Pressurized Water Reactor between two instants: from the moment the accident occurs till - but not including - the possible meltdown of the nuclear fuel, this requiring other hypotheses and algorithms. SIPA was made to a double specification: (1) to satisfy the needs of the utility EdF(SPT) in terms of training, by making use of a relevant and pedagogical tool for accident situations in real time, for the use of Shift Safety Advisors (SSAs), Shift Teams and Crisis Teams; (2) to satisfy the needs of the designer EdF(SEPTEN) in terms of safety studies by means of a tool making it possible with greater ease and efficiency to deal with the instruction of the systems making up the unit, validate the control procedures and perform crisis drill scenarios. Meeting with initial specifications of training for accidents which cause violent thermohydraulic disturbances, two 'SSA training configurations' have been developed for the 34 EdF 900 MW reactors, with almost identical primary circuits, and the 20 EdF 1300 MW reactors. Both of these are organized around the main CATHARE-SIMU code, which thereby determines the domain in which SIPA will be used. SIPA was commissioned on December 23, 1991. The first version, installed at EdF-SEPTEN, Lyon, is called SIPA 1 and has been used for training since June 1, 1992. (Z.S.) 3 tabs., 5 figs.

23394 (INIS-mf–13502, pp. 211-223) **Development of an effective man-machine interface for the Sizewell B main control room.** Wright, P.J.G. (Nuclear Electric plc (United Kingdom)); Leach, M.G. European Nuclear Society (ENS), Bern (Switzerland); Czech Nuclear Society, Prague (Czech Republic); Slovak Nuclear Society, Bratislava (Slovakia). Jan 1993. (CONF-921068–: East-West topical meeting: the safe and reliable operation of light water reactor NPP's, Prague (Czechoslovakia), 18-21 Oct 1992). In *Topform '92: the safe and reliable operation of LWR NPPs. Vol. I: Invited plenary session papers.* [235p.] Order Number DE93626240. Source: OSTI; NTIS (US Sales Only); INIS.

Sizewell B, currently under construction, is the first pressurized water reactor power station to be built in the UK. Although the design is based on the SNUPPS design, which operates very successfully at Callaway and Wolf Creek in the USA, several changes have been made to meet UK licensing requirements and improve safety. These changes include an entirely new control room design which takes advantage of modern control and instrumentation technology to provide the operator with a more effective interface with the plant. A brief description is given of the way in which the design of the Sizewell B control room has been developed. The design is presented of the control room layout, data display system, plant overview panel, main control suite, general service panel, electrical services panel, document and auxiliary monitoring facility. (Z.S.) 3 figs.

23395 (INIS-mf–13502, pp. 224-235) **Overview on development of in-plant emergency operating procedures.** Wanner, A. (Electrowatt Engineering Services Ltd., Zurich (Switzerland)). European Nuclear Society (ENS), Bern (Switzerland); Czech Nuclear Society, Prague (Czech Republic); Slovak Nuclear Society, Bratislava (Slovakia). Jan 1993. (CONF-921068–: East-West topical meeting: the safe and reliable operation of light water reactor NPP's, Prague (Czechoslovakia), 18-21 Oct 1992). In *Topform '92: the safe and reliable operation of LWR NPPs. Vol. I: Invited plenary session papers.* [235p.] Order Number DE93626240. Source: OSTI; NTIS (US Sales Only); INIS.

An analysis of the existing Emergency Operating Procedures (EOPs) - based on a single event, design basis accident approach - has shown that they are inadequate to cope with unforeseen accident scenarios and should be extended to cover a wider range of accident conditions. EOPs that cover the expanded range are also called 'Accident Management Procedures' (AMPs) and form an important part of the overall plant accident management strategy. A brief overview is presented of the current status of the EOPs and AMPs that were developed during the recent years by some of the major power reactor suppliers and operators (Westinghouse, EdF, Siemens(KWU)). (Z.S.) 3 figs.

23396 (INIS-mf–13503) **Topform '92: the safe and reliable operation of LWR NPPs. Vol. II: Poster papers.** European Nuclear Society (ENS), Bern (Switzerland); Czech Nuclear Society, Prague (Czech Republic); Slovak Nuclear Society, Bratislava (Slovakia). Jan 1993. [245p.] (CONF-921068–: East-West topical meeting: the safe and reliable operation of light water reactor NPP's, Prague (Czechoslovakia), 18-21 Oct 1992). Order Number DE93625345. Source: OSTI; NTIS (US Sales Only); INIS.

Out of the 54 poster papers contained in the proceedings, 53 were inputted to the INIS system. The topics covered include operational training and simulation, inspection, maintenance and component replacement, backfitting experience, instrumentation, man-machine interface, software and procedures. (Z.S.).

23397 (INIS-mf–13503, pp. 4-7) **Three-dimensional reactor model for the Paks NPP full-scope simulator.** Gyori, C. (Hungarian Academy of Sciences, Budapest (Hungary). Central Research Inst. for Physics); Hegyi, G.; Hozer, Z.; Kereszturi, A.; Maraczy, C. European Nuclear Society (ENS), Bern (Switzerland); Czech Nuclear Society, Prague (Czech Republic); Slovak Nuclear Society, Bratislava (Slovakia). Jan 1993. (CONF-921068–: East-West topical meeting: the safe and reliable operation of light water reactor NPP's, Prague (Czechoslovakia), 18-21 Oct 1992). In *Topform '92: the safe and reliable operation of LWR NPPs. Vol. II: Poster papers.* [245p.] Order Number DE93625345. Source: OSTI; NTIS (US Sales Only); INIS.

The reactor model includes thermohydraulic and neutron-physical components. The thermohydraulic model is based on the SMABRE code developed at the Technical Research Centre of Finland for the analysis of loss-of-coolant transients in PWRs. The fuel rod model will be replaced by a new software module providing a comprehensive description of the behavior of fuel rods during reactor transients and hypothetical accidents. The calculation is performed in four individual models: fuel rod temperature model, fuel rod internal pressure model, fuel rod deformation model and fuel rod failure model. In the neutron-physical model the core is calculated with nodes for all of the 349 fuel assemblies, and each assembly is calculated in ten layers. (Z.S.) 1 fig., 5 refs.

23398 (INIS-mf–13503, pp. 16-23) **STRATEG - an incident training system for thermohydraulic effects and principles.** Rehn, H. (Nuklear-Ingenieur Service GmbH, Hanau (Germany)); Majohr, N. European Nuclear Society (ENS), Bern (Switzerland); Czech Nuclear Society, Prague (Czech Republic); Slovak Nuclear Society, Bratislava (Slovakia). Jan 1993. (CONF-921068–: East-West topical meeting: the safe and reliable operation of light water reactor NPP's, Prague (Czechoslovakia), 18-21 Oct 1992). In *Topform '92: the safe and reliable operation of LWR NPPs. Vol. II: Poster papers.* [245p.] Order Number DE93625345. Source: OSTI; NTIS (US Sales Only); INIS.

STRATEG is a 1:10 scale glass model of a PWR (Biblis B reactor coolant circuit) built by RWE in 1986 on the site of the Biblis plant as a training model. The model can be used for training of normal operation and incident situations since all important operating and incident sequences of a PWR can be simulated. Thermodynamic phenomena can also be demonstrated occurring under various operating situations and in particular associated with malfunctions. (Z.S.) 1 tab., 3 figs., 1 ref.

23399 (INIS-mf–13503, pp. 31-34) **The extension of the Paks full-scale simulator to severe accidents.** Vegh, E. (Hungarian Academy of Sciences, Budapest (Hungary). Central Research Inst. for Physics); Janosy, J.S. European Nuclear Society (ENS), Bern (Switzerland); Czech Nuclear Society, Prague (Czech Republic); Slovak Nuclear Society, Bratislava (Slovakia). Jan 1993. (CONF-921068–: East-West topical meeting: the safe and reliable operation of light water reactor NPP's, Prague (Czechoslovakia), 18-21 Oct 1992). In *Topform '92: the safe and reliable operation of LWR NPPs. Vol. II: Poster papers.* [245p.] Order Number DE93625345. Source: OSTI; NTIS (US Sales Only); INIS.

A second model upgrading started in 1991 and will be completed by the end of 1992. In the simulator, the whole primary circuit system with its auxiliary systems is replaced. The most significant

improvements are: a detailed 3D reactor model; thermohydraulics of the primary circuit; detailed containment and pressure suppression system models; a fuel element model, radioactivity transport in the primary circuit and in the containment. (Z.S.) 2 figs., 3 refs.

23400 (INIS-mf–13503, pp. 35-38) **Organizational aspects of recruiting, training, maintaining the level of professional skills and retraining of NPP operations personnel in Russia.** Veltchinsky, V. (Russian Research Institute of Nuclear Power Plant Operations (Russian Federation)). European Nuclear Society (ENS), Bern (Switzerland); Czech Nuclear Society, Prague (Czech Republic); Slovak Nuclear Society, Bratislava (Slovakia). Jan 1993. (CONF-921068–: East-West topical meeting: the safe and reliable operation of light water reactor NPP's, Prague (Czechoslovakia), 18-21 Oct 1992). In *Topform '92: the safe and reliable operation of LWR NPPs. Vol. II: Poster papers.* [245p.] Order Number DE93625345. Source: OSTI; NTIS (US Sales Only); INIS.

The organization of personnel work during WWER-1000 operation is presented as recommended by the Russian operating organization. The system is described of recruiting, training control of professional activities, maintaining of professional skills and retraining of the Russian nuclear power plant operation personnel (PKPO system). The basic documentation of the PKPO system is listed. (Z.S.) 1 fig.

23401 (INIS-mf–13503, pp. 39-42) **Detailed containment model for the Paks NPP full-scope simulator.** Vigassy, J. (Hungarian Academy of Sciences, Budapest (Hungary). Central Research Inst. for Physics). European Nuclear Society (ENS), Bern (Switzerland); Czech Nuclear Society, Prague (Czech Republic); Slovak Nuclear Society, Bratislava (Slovakia). Jan 1993. (CONF-921068–: East-West topical meeting: the safe and reliable operation of light water reactor NPP's, Prague (Czechoslovakia), 18-21 Oct 1992). In *Topform '92: the safe and reliable operation of LWR NPPs. Vol. II: Poster papers.* [245p.] Order Number DE93625345. Source: OSTI; NTIS (US Sales Only); INIS.

The modelling principles in simulating the containment behavior are presented. The following processes are considered in containment simulation: thermohydraulic processes in the rooms and trays of the containment; detailed heat kinetics of the walls; behavior of the depressurization and ventilation systems; failures in the containment; distribution of air, steam/water, hydrogen and boric acid; the amount of radioactive contaminants in the sealed room systems. (Z.S.) 2 figs.

23402 (INIS-mf–13503, pp. 46-49) **Inspection validation and its role in the UK nuclear power programme.** Conroy, P.J. (AEA Technology, Warrington (United Kingdom). Inspection Validation Centre); Smalley, S. European Nuclear Society (ENS), Bern (Switzerland); Czech Nuclear Society, Prague (Czech Republic); Slovak Nuclear Society, Bratislava (Slovakia). Jan 1993. (CONF-921068–: East-West topical meeting: the safe and reliable operation of light water reactor NPP's, Prague (Czechoslovakia), 18-21 Oct 1992). In *Topform '92: the safe and reliable operation of LWR NPPs. Vol. II: Poster papers.* [245p.] Order Number DE93625345. Source: OSTI; NTIS (US Sales Only); INIS.

A summary of the validation trials is given conducted in support of the ultrasonic inspections covering the various fabrication stages of the UK's Sizewell 'B' PWR pressure vessel. The validation programme has provided strong evidence that the ultrasonic inspections carried out by validated operators using validated procedures will achieve a standard of inspection that will ensure that the reactor pressure vessel enters service free from any credible defects and that during the service life of the vessel any credible in-service defects that may develop to threaten the integrity of the pressure vessel will be identified by the periodic in-service inspections. (Z.S.) 1 tab., 1 fig.

23403 (INIS-mf–13503, pp. 50-55) **In-service inspection of WWER steam generators.** Guenon, Y. (Intercontrole (France)). European Nuclear Society (ENS), Bern (Switzerland); Czech Nuclear Society, Prague (Czech Republic); Slovak Nuclear Society, Bratislava (Slovakia). Jan 1993. (CONF-921068–: East-West topical meeting: the safe and reliable operation of light water reactor NPP's, Prague (Czechoslovakia), 18-21 Oct 1992). In *Topform '92: the safe and reliable operation of LWR NPPs. Vol. II: Poster papers.* [245p.] Order Number DE93625345. Source: OSTI; NTIS (US Sales Only); INIS.

In July 1990, INTERCONTROLE supplied Atomenergoremont with two eddy current systems (GIBBON robot) for inspecting steam generator tubes in Soviet WWER-type reactors. The robot accesses and inspects all tubes in a cylinder section of 800 mm over 90 degrees and gets round plugged tubes either by rotation or by vertical displacement. The eddy current inspection system is controlled from a mobile shelter located 200 m from the steam generator. The control system controls all subsystems on the GIBBON and axial rotating probe drives on an AT personal computer. The unique data acquisition features include the HARMONIC 210 eddy current instrument and data acquisition and verification software. Verification of axial and rotating probe data is based on AIDA, DESIREE and ESTELLE software, developed jointly by INTERCONTROLE and EdF. (Z.S.) 4 figs., 1 ref.

23404 (INIS-mf–13503, pp. 60-63) **A computerized event and maintenance data system at Loviisa nuclear power plant.** Jankala, K.E. (Imatran Voima Oy, Vantaa, (Finland)); Saarelainen, P.; Vaurio, J.K. European Nuclear Society (ENS), Bern (Switzerland); Czech Nuclear Society, Prague (Czech Republic); Slovak Nuclear Society, Bratislava (Slovakia). Jan 1993. (CONF-921068–: East-West topical meeting: the safe and reliable operation of light water reactor NPP's, Prague (Czechoslovakia), 18-21 Oct 1992). In *Topform '92: the safe and reliable operation of LWR NPPs. Vol. II: Poster papers.* [245p.] Order Number DE93625345. Source: OSTI; NTIS (US Sales Only); INIS.

An on-line failure and maintenance event data system (which is a part of the Loviisa power plant information system) is described as developed and implemented at the Loviisa power plant. The system has been in operation since 1989, and the data base now covers more than 10 years of operation. The system contains a complete unavailability history, i.e. failures, repairs, replacements, scheduled or unscheduled preventive maintenance and periodic testing or service actions for any component that is relevant to plant safety, risk or economic production. The data base provides useful feedback from operating experience and can support e.g. studies on optimal maintenance and testing, planning of spare parts inventory and repair resources, updating of reliability parameters for risk studies, etc. (Z.S.) 4 refs.

23405 (INIS-mf–13503, pp. 68-71) **Inspection and repair of nuclear components.** Lahner, K. (ABB Reaktor GmbH, Mannheim (Germany)); Poetz, F. European Nuclear Society (ENS), Bern (Switzerland); Czech Nuclear Society, Prague (Czech Republic); Slovak Nuclear Society, Bratislava (Slovakia). Jan 1993. (CONF-921068–: East-West topical meeting: the safe and reliable operation of light water reactor NPP's, Prague (Czechoslovakia), 18-21 Oct 1992). In *Topform '92: the safe and reliable operation of LWR NPPs. Vol. II: Poster papers.* [245p.] Order Number DE93625345. Source: OSTI; NTIS (US Sales Only); INIS.

Despite careful design, manufacturing and operation, some of the important safety-relevant components show deterioration with time. Because of activation and contamination of these components, their inspection and repair has to be performed with manipulators. Some sophisticated manipulators are described, built by ABB Reaktor and used for inspection, maintenance and repair of PWR steam generators, fuel alignment pins, core baffle former bolts and reactor pressure vessel head penetrations. (Z.S.) 7 figs.

23406 (INIS-mf–13503, pp. 96-99) **Validation of emergency procedures for improved safety and reliability.** Boucau, J. (Westinghouse, Brussels (Belgium)); Bock, C. de. European Nuclear Society (ENS), Bern (Switzerland); Czech Nuclear Society, Prague (Czech Republic); Slovak Nuclear Society, Bratislava (Slovakia). Jan 1993. (CONF-921068–: East-West topical meeting: the safe and reliable operation of light water reactor NPP's, Prague (Czechoslovakia), 18-21 Oct 1992). In *Topform '92: the safe and reliable operation of LWR NPPs. Vol. II: Poster papers.* [245p.] Order Number DE93625345. Source: OSTI; NTIS (US Sales Only); INIS.

Westinghouse together with operation people from the Westinghouse Owners Group (WOG) has been working since 1981 on the development of Emergency Response Guidelines (ERG's). The

ERG's have been constructed to be generic and applicable to all Westinghouse designed PWR plants. The post-accident recovery technique of small break LOCA is described based on the guideline prescribed in the ERG's. It demonstrates that plant specific analyses are quite efficient to improve emergency procedures, especially in case of non-standard plants, like WWER's. For such plants, it is recommended to verify the correctness of the post-accident recovery technique with a tool that can interactively simulate the operator actions, with best-estimate assumptions. Such analyses also provide the plant personnel with plant specific background documents that are quite convenient for their training on emergency procedures. (Z.S.) 1 fig.

23407 (INIS-mf–13503, pp. 104-110) **The Belgian experience with the safety reassessment of nuclear power plants.** Damsin, M. (Belgatom SA, Brussels (Belgium)); Danhier, B. European Nuclear Society (ENS), Bern (Switzerland); Czech Nuclear Society, Prague (Czech Republic); Slovak Nuclear Society, Bratislava (Slovakia). Jan 1993. (CONF-921068–: East-West topical meeting: the safe and reliable operation of light water reactor NPP's, Prague (Czechoslovakia), 18-21 Oct 1992). In *Topform '92: the safe and reliable operation of LWR NPPs. Vol. II: Poster papers.* [245p.] Order Number DE93625345. Source: OSTI; NTIS (US Sales Only); INIS.

In Belgium, the safety reevaluation of operating nuclear power plants is due by law after each ten-year period of operation of a plant. Belgium has gained valuable experience in this particular field during the reevaluation of their three oldest nuclear power plants. The Belgian approach to the safety reassessment of nuclear power plants is described (methodology, process of safety reevaluation studies) and two examples are presented, i.e. the Tihange-1 seismic reevaluation and the Doel 1/2 emergency systems including cost evaluation. (Z.S.).

23408 (INIS-mf–13503, pp. 111-114) **Steam generator replacement at Doel 3 NPP (Belgium).** Danhier, B. (Belgatom SA, Brussels (Belgium)). European Nuclear Society (ENS), Bern (Switzerland); Czech Nuclear Society, Prague (Czech Republic); Slovak Nuclear Society, Bratislava (Slovakia). Jan 1993. (CONF-921068–: East-West topical meeting: the safe and reliable operation of light water reactor NPP's, Prague (Czechoslovakia), 18-21 Oct 1992). In *Topform '92: the safe and reliable operation of LWR NPPs. Vol. II: Poster papers.* [245p.] Order Number DE93625345. Source: OSTI; NTIS (US Sales Only); INIS.

The reasons are presented that led to the conclusion that the most cost-effective strategy for the Doel 3 unit was the immediate replacement of the SG. Discussed are the advantages and drawbacks of the replacement techniques, the so-called 2, 3 and 4 cuts methods. The advantages are emphasized of intensive use of computer aided engineering in this kind of backfitting. The methodology applied to combine a power uprating of 10% over the nominal power with the steam generator replacement is presented. (author) 1 fig.

23409 (INIS-mf–13503, pp. 115-118) **PWR reload safety evaluation methodology.** Doshi, P.K. (Westinghouse Electric Corp., Pittsburgh, PA (United States)); Chapin, D.L.; Love, D.S. European Nuclear Society (ENS), Bern (Switzerland); Czech Nuclear Society, Prague (Czech Republic); Slovak Nuclear Society, Bratislava (Slovakia). Jan 1993. (CONF-921068–: East-West topical meeting: the safe and reliable operation of light water reactor NPP's, Prague (Czechoslovakia), 18-21 Oct 1992). In *Topform '92: the safe and reliable operation of LWR NPPs. Vol. II: Poster papers.* [245p.] Order Number DE93625345. Source: OSTI; NTIS (US Sales Only); INIS.

The current practice for WWER safety analysis is to prepare the plant Safety Analysis Report (SAR) for initial plant operation. However, the existing safety analysis is typically not evaluated for reload cycles to confirm that all safety limits are met. In addition, there is no systematic reanalysis or reevaluation of the safety analyses after there have been changes made to the plant. The Westinghouse process is discussed which is in contrast to this and in which the SAR conclusions are re-validated through evaluation and/or analysis of each reload cycle. (Z.S.).

23410 (INIS-mf–13503, pp. 119-122) **Hydrogen management techniques in German LWR-containments.** Berg, H.P. (Bundesamt fuer Strahlenschutz, Salzgitter (Germany)); Froehmel, T. European Nuclear Society (ENS), Bern (Switzerland); Czech Nuclear Society, Prague (Czech Republic); Slovak Nuclear Society, Bratislava (Slovakia). Jan 1993. (CONF-921068–: East-West topical meeting: the safe and reliable operation of light water reactor NPP's, Prague (Czechoslovakia), 18-21 Oct 1992). In *Topform '92: the safe and reliable operation of LWR NPPs. Vol. II: Poster papers.* [245p.] Order Number DE93625345. Source: OSTI; NTIS (US Sales Only); INIS.

Investigations are described which are necessary to develop an accident management concept for German PWRs, in particular possible solutions of the hydrogen problem resulting from a core melting accident. This work is an important part of the Nuclear Regulatory Research Programme initiated and financed by the Federal Office for Radiation Protection (BfS). Two fundamental strategies are discussed: prevention of the formation of inflammable gas mixtures by making the atmosphere of the containment inert, and mitigation of the consequence of possible combustion by limiting the local hydrogen concentration. (Z.S.) 1 fig.

23411 (INIS-mf–13503, pp. 132-134) **The model experiments on the stationary outflow in the retaining system.** Kucak, L. (Slovenska Vysoka Skola Technicka, Bratislava (Czechoslovakia). Strojnicka Fakulta). European Nuclear Society (ENS), Bern (Switzerland); Czech Nuclear Society, Prague (Czech Republic); Slovak Nuclear Society, Bratislava (Slovakia). Jan 1993. (CONF-921068–: East-West topical meeting: the safe and reliable operation of light water reactor NPP's, Prague (Czechoslovakia), 18-21 Oct 1992). In *Topform '92: the safe and reliable operation of LWR NPPs. Vol. II: Poster papers.* [245p.] Order Number DE93625345. Source: OSTI; NTIS (US Sales Only); INIS.

The existing protection system for WWER-type nuclear power plants was designed to cope with a rupture of the pipeline with diameter less than 200 mm. The new requirements on the protection system, ie., to retain accident product outflow from the 500 mm main circulation pipe represent a great technical problem. In order to obtain data for designing a new primary pipe accident retaining system for the Bohunice V-1 power plant with overpressure not exceeding 100 kPa, model experiments were carried out. Basic features of the experiments are given. (Z.S.) 1 fig.

23412 (INIS-mf–13503, pp. 135-141) **Measures taken to improve nuclear safety on EdF PWRs in operation.** Kus, J.-P. (Electricite de France CNIPE, Lyon (France)); Norvez, G. European Nuclear Society (ENS), Bern (Switzerland); Czech Nuclear Society, Prague (Czech Republic); Slovak Nuclear Society, Bratislava (Slovakia). Jan 1993. (CONF-921068–: East-West topical meeting: the safe and reliable operation of light water reactor NPP's, Prague (Czechoslovakia), 18-21 Oct 1992). In *Topform '92: the safe and reliable operation of LWR NPPs. Vol. II: Poster papers.* [245p.] Order Number DE93625345. Source: OSTI; NTIS (US Sales Only); INIS.

In parallel with its major nuclear programme (56 PWR units in service or under construction), France has developed an original philosophy in the field of Nuclear Safety. This comprehensive philosophy ensures a fine balance and coordination between design and operation, it provides a methodology to design, construct and operate a safe nuclear plant. Actual experience is then continuously compared to the initial expectation and the methodology refined whenever necessary. This methodology is fully applied to the new 1400 MWe plant series presently under construction. The essential elements are also backfitted into all previous units, thereby giving them an equivalent level of safety. The French PWR park can therefore be considered as very homogeneous with regard to its safety level, regarding both its design and operation. (author).

23413 (INIS-mf–13503, pp. 142-144) **Electrical penetrations for use in WWER nuclear power plant containment vessels.** Lankenau, W.R. (Imaging and Sensing Technology, Horseheads, New York (United States)); Forejt, V. European Nuclear Society (ENS), Bern (Switzerland); Czech Nuclear Society, Prague (Czech Republic); Slovak Nuclear Society, Bratislava (Slovakia). Jan 1993. (CONF-921068–: East-West topical meeting: the safe and reliable operation of light water reactor NPP's, Prague (Czechoslovakia),

18-21 Oct 1992). In *Topform '92: the safe and reliable operation of LWR NPPs. Vol. II: Poster papers.* [245p.] Order Number DE93625345. Source: OSTI; NTIS (US Sales Only); INIS.

A description is given of the electrical penetration assembly designed by Imaging and Sensing Technology (USA) for the Temelin nuclear power plant. (Z.S.) 1 fig.

23414 (INIS-mf–13503, pp. 145-149) **Backfitting experience, Loviisa nuclear power plant, Finland.** Mohsen, B. (IVO International Ltd, Vantaa (Finland)); Vaurio, J. European Nuclear Society (ENS), Bern (Switzerland); Czech Nuclear Society, Prague (Czech Republic); Slovak Nuclear Society, Bratislava (Slovakia). Jan 1993. (CONF-921068–: East-West topical meeting: the safe and reliable operation of light water reactor NPP's, Prague (Czechoslovakia), 18-21 Oct 1992). In *Topform '92: the safe and reliable operation of LWR NPPs. Vol. II: Poster papers.* [245p.] Order Number DE93625345. Source: OSTI; NTIS (US Sales Only); INIS.

Some examples of major backfitting planned for Loviisa or already carried out are described. The level 1 probabilistic safety assessment (PSA) was completed in 1989 for the internal initiators of Loviisa power plant, unit one. The results of PSA analysis demonstrated among other things the need to treat three types of initiators: loss of safety instrument cooling room, primary to secondary leaks, and loss of off-site power. The following examples of deterministically based backfitting are given: standby emergency feed water system and containment external spray. The Loviisa PSA analysis for internal events, which is so far the first performed for WWER-type reactors, is being continuously updated and used as a living PSA for decision making. Very essential modifications were carried out or are under way of both hardware and procedures. Fire, flood and level 2 analysis are under way and will be finished in the near future. (Z.S.) 5 figs.

23415 (INIS-mf–13503, pp. 150-155) **Seismic assessment of Kozloduy WWER-440, model 230 nuclear power plant.** Monette, P. (Westinghouse Energy Systems International, Brussels (Belgium)); Baltus, R.; Yanev, P.; Campbell, R. European Nuclear Society (ENS), Bern (Switzerland); Czech Nuclear Society, Prague (Czech Republic); Slovak Nuclear Society, Bratislava (Slovakia). Jan 1993. (CONF-921068–: East-West topical meeting: the safe and reliable operation of light water reactor NPP's, Prague (Czechoslovakia), 18-21 Oct 1992). In *Topform '92: the safe and reliable operation of LWR NPPs. Vol. II: Poster papers.* [245p.] Order Number DE93625345. Source: OSTI; NTIS (US Sales Only); INIS.

A preliminary report is given of the findings of an IAEA sponsored walkdown of the WWER-440, model 230 at Kozloduy, in May 1991. The scope of the IAEA mission was to determine the lower bound seismic capacity of the plant and to make recommendations for improvements to increase the earthquake resistance. The methodology utilized in the assessment is that used for evaluation of the seismic margin in U.S. nuclear power plants subjected to earthquakes beyond their design basis. Included in the assessment is the establishment of a safe shutdown path which would include the capacity to mitigate a small break in the primary system, performance of a walkdown of the safe shutdown path and calculation of the high-confidence-of-low-probability-of-failure (HCLPF) of the safe shutdown path. Excluding system design deficiency relative to U.S. and Western Europe standards, it was found that the plant has many seismic vulnerabilities similar to those that existed in many of the U.S. plants prior to about 1979 when the Systematic Evaluation Program was initiated. (Z.S.) 1 tab., 1 fig.

23416 (INIS-mf–13503, pp. 156-159) **Development of MAAP-WWER.** Prior, R.P. (Westinghouse Energy Systems, Brussels (Belgium)); Plys, M.G. European Nuclear Society (ENS), Bern (Switzerland); Czech Nuclear Society, Prague (Czech Republic); Slovak Nuclear Society, Bratislava (Slovakia). Jan 1993. (CONF-921068–: East-West topical meeting: the safe and reliable operation of light water reactor NPP's, Prague (Czechoslovakia), 18-21 Oct 1992). In *Topform '92: the safe and reliable operation of LWR NPPs. Vol. II: Poster papers.* [245p.] Order Number DE93625345. Source: OSTI; NTIS (US Sales Only); INIS.

The Modular Accident Analysis Program (MAAP) is a tool for modelling the response of a light water reactor plant to severe accidents. It is now widely used for many applications in the U.S., Western Europe and Japan. In the near future, a number of safety studies of WWER type reactors designed in the former USSR will be performed. A summary is provided of the development effort underway to enable MAAP code to model these reactor types. Presented are a brief review of the MAAP code, a summary of the new modelling effort, and applications foreseen for the new version of the code. The WWER-440 version of MAAP, completion of which is scheduled for the third quarter of 1992, will be needed to perform WWER safety assessments, in particular: level 1 PSA (success criteria, event sequence definition), level 2 PSA (event sequence definition, source term analysis), assessment of confinement performance, source term and radiological consequence analyses, system evaluations, including the thermal shock of reactor vessels. (Z.S.) 1 fig.

23417 (INIS-mf–13503, pp. 166-169) **Nuclear power plant safety under military threats.** Stritar, A. (Institut Jozef Stefan, Ljubljana (Yugoslavia)); Mavko, B. European Nuclear Society (ENS), Bern (Switzerland); Czech Nuclear Society, Prague (Czech Republic); Slovak Nuclear Society, Bratislava (Slovakia). Jan 1993. (CONF-921068–: East-West topical meeting: the safe and reliable operation of light water reactor NPP's, Prague (Czechoslovakia), 18-21 Oct 1992). In *Topform '92: the safe and reliable operation of LWR NPPs. Vol. II: Poster papers.* [245p.] Order Number DE93625345. Source: OSTI; NTIS (US Sales Only); INIS.

The Krsko nuclear power plant in Slovenia was probably the first in the world that found itself in the middle of a war region. A number of preventive measures performed during and immediately after the war in summer 1991 by the plant personnel as well as some of related activities of the Reactor Engineering Division of the 'Jozef Stefan' Institute are described. All efforts were aimed at the minimization of the possible public radiological consequences during a military attack. The critical safety functions in such conditions were checked. Concern was further devoted to maintenance of the core cooling in the core and to integrity of the spent fuel pit. The cold shutdown mode was found to be the most appropriate option. After selecting the cold shutdown mode as a most suitable operational state of the plant, further studies of the vulnerability were done. In addition to possible direct damage to structures, that would cause release of radioactivity, two important subjects were considered: AC and DC power supply and the ultimate heat sink. A quick analysis during the crisis has shown that the consequences of a military attack against the plant by jet fighters could be serious, but with the proper preventive measures and preparedness the environmental consequences could be minimized. (Z.S.) 1 fig., 1 ref.

23418 (INIS-mf–13503, pp. 174-184) **The Westinghouse approach - an I and C modernization program for WWERs.** Werner, C.L. (Westinghouse Electric Corp., Pittsburgh, PA (United States)); Wassel, W.W.; Novak, V. European Nuclear Society (ENS), Bern (Switzerland); Czech Nuclear Society, Prague (Czech Republic); Slovak Nuclear Society, Bratislava (Slovakia). Jan 1993. (CONF-921068–: East-West topical meeting: the safe and reliable operation of light water reactor NPP's, Prague (Czechoslovakia), 18-21 Oct 1992). In *Topform '92: the safe and reliable operation of LWR NPPs. Vol. II: Poster papers.* [245p.] Order Number DE93625345. Source: OSTI; NTIS (US Sales Only); INIS.

When entering into a design program that is a marriage between two designs it is very difficult to separate self imposed design criteria from the requirements of the program. Therefore, the criteria of and the requirements for the Westinghouse modernization program will be discussed as one. These are outlined below: (1) The OSART Mission that was conducted by the IAEA at the Temelin Plant in 1990 identified the need to provide a new comprehensive Safety Analysis to verify the various aspects of the WWER safety system design. This recommendation is one that Westinghouse will provide as part of the WWER I and C Modernization Program. The design, no matter how well proven or verified from a hardware design point of view, is only as good as the basis for the system design; (2) Minimize the impact on the civil design aspects of the plant where possible and where this requirements do not affect the safety features of the design; (3) Ensure compatibility of the design to meet the latest US NRC requirements and those of the implementing country, applicable to the systems functional and hardware designs. This is a Westinghouse standard corporate requirement for

all nuclear plant and systems design whether they be foreign or domestic; (4) Provide the most modern, proven design for the I and C systems. Application of the Westinghouse Instrumentation and Control microprocessor based design to the WWER Modernization Program will provide the basis for upgrading plants to meet western standards. (author) 6 figs., 1 ref.

23419 (INIS-mf–13503, pp. 185-186) **French load follow technology.** Bruyere, M. (Framatome, La Defense (France)). European Nuclear Society (ENS), Bern (Switzerland); Czech Nuclear Society, Prague (Czech Republic); Slovak Nuclear Society, Bratislava (Slovakia). Jan 1993. (CONF-921068–: East-West topical meeting: the safe and reliable operation of light water reactor NPP's, Prague (Czechoslovakia), 18-21 Oct 1992). In *Topform '92: the safe and reliable operation of LWR NPPs. Vol. II: Poster papers.* [245p.] Order Number DE93625345. Source: OSTI; NTIS (US Sales Only); INIS.

Since the early 80's, PWR units in France had to evolve from base load operation to intensive load follow operation. Information is given on the set-up programme, the technical improvements implemented, the licensing efforts and the experience gained during years of load follow operation in France. (Z.S.).

23420 (INIS-mf–13503, pp. 195-199) **Development of an intelligent CAI system for a distributed processing environment.** Fujii, M. (Mitsubishi Electric Corp., Amagasaki (Japan)); Sasaki, K.; Ohi, T.; Itoh, T. European Nuclear Society (ENS), Bern (Switzerland); Czech Nuclear Society, Prague (Czech Republic); Slovak Nuclear Society, Bratislava (Slovakia). Jan 1993. (CONF-921068–: East-West topical meeting: the safe and reliable operation of light water reactor NPP's, Prague (Czechoslovakia), 18-21 Oct 1992). In *Topform '92: the safe and reliable operation of LWR NPPs. Vol. II: Poster papers.* [245p.] Order Number DE93625345. Source: OSTI; NTIS (US Sales Only); INIS.

In order to operate a nuclear power plant optimally in both normal and abnormal situations, the operators are trained using an operator training simulator in addition to classroom instruction. Individual instruction using a CAI (Computer-Assisted Instruction) system has become popular as a method of learning plant information, such as plant dynamics, operational procedures, plant systems, plant facilities, etc. The outline is described of a proposed network-based intelligent CAI system (ICAI) incorporating multi-medial PWR plant dynamics simulation, teaching aids and educational record management using the following environment: existing standard workstations and graphic workstations with a live video processing function, TCP/IP protocol of Unix through Ethernet and X window system. (Z.S.) 3 figs., 2 refs.

23421 (INIS-mf–13503, pp. 200-203) **DIMOS: a new generation of nuclear power plant process monitoring systems.** Vlaminck, M. de (Belgatom SA, Brussels (Belgium)); Gilliot, B.; Remacle, J. European Nuclear Society (ENS), Bern (Switzerland); Czech Nuclear Society, Prague (Czech Republic); Slovak Nuclear Society, Bratislava (Slovakia). Jan 1993. (CONF-921068–: East-West topical meeting: the safe and reliable operation of light water reactor NPP's, Prague (Czechoslovakia), 18-21 Oct 1992). In *Topform '92: the safe and reliable operation of LWR NPPs. Vol. II: Poster papers.* [245p.] Order Number DE93625345. Source: OSTI; NTIS (US Sales Only); INIS.

A new generation of nuclear power plant supervision systems is described, called DIMOS (DIstributed MOnitoring System). It was installed in August 1991 at the Doel nuclear power plant and is now monitoring reactors 1 and 2. The system represents one of the largest and most advanced process monitoring systems in operation. DIMOS has successfully provided the solution to the old system's limitations such as functional deficiencies, low response time, management and coherence of the data, maintenance costs, spare parts, and system availability. The use of the software development methodologies HOOD and ADA have not only allowed a rapid integration and installation of a robust system, but will also make further developments and improvements possible with maximum flexibility. (Z.S.) 2 figs.

23422 (INIS-mf–13503, pp. 204-206) **SEJV2 software package for radiation monitoring system of WWER 440 NPP.** Kapisovsky, V. (Vyskumny Ustav Jadrovych Elektrarni, Trnava (Czechoslovakia)); Jancik, O.; Kubik, I.; Bena, J. European Nuclear Society (ENS), Bern (Switzerland); Czech Nuclear Society, Prague (Czech Republic); Slovak Nuclear Society, Bratislava (Slovakia). Jan 1993. (CONF-921068–: East-West topical meeting: the safe and reliable operation of light water reactor NPP's, Prague (Czechoslovakia), 18-21 Oct 1992). In *Topform '92: the safe and reliable operation of LWR NPPs. Vol. II: Poster papers.* [245p.] Order Number DE93625345. Source: OSTI; NTIS (US Sales Only); INIS.

The main part of the radiation monitoring system at a WWER-440 (213 reactor type) nuclear power plant is the centralized 400-channel monitoring system 'SEJVAL' servicing twin reactor units. The SEJV2 software package is described developed to run on a PC with an IFS2 interface to the SEJVAL radiation monitoring system. It provides enhanced data presentation, record keeping and report generation, thus improving the efficiency of the health physics shift. The system was for the first time implemented at the Jaslovske Bohunice V-2 nuclear power plant with encouraging results. (Z.S.) 3 refs.

23423 (INIS-mf–13503, pp. 211-214) **Advanced core monitoring technology for WWER reactors.** Nguyen, T.Q. (Westinghouse Commercial Nuclear Fuel Division, Pittsburgh, PA (United States)); Casadei, A.L.; Doshi, P.K. European Nuclear Society (ENS), Bern (Switzerland); Czech Nuclear Society, Prague (Czech Republic); Slovak Nuclear Society, Bratislava (Slovakia). Jan 1993. (CONF-921068–: East-West topical meeting: the safe and reliable operation of light water reactor NPP's, Prague (Czechoslovakia), 18-21 Oct 1992). In *Topform '92: the safe and reliable operation of LWR NPPs. Vol. II: Poster papers.* [245p.] Order Number DE93625345. Source: OSTI; NTIS (US Sales Only); INIS.

The Westinghouse BEACON online monitoring system has been developed to provide continuous core monitoring and operational support for pressurized water reactor using movable detectors (fission chamber) and core thermocouples. The basic BEACON core monitoring methodology is described. Traditional WWER reactors use rhodium fixed in-core detectors as the means to provide detailed core power distribution for surveillance purposes. An adapted version of the BEACON advanced core monitoring and support system is described which seems to be, due to the different demand/response requirements, the optimal solution (for routine surveillance and anomaly detection) for WWER reactors with existing fixed in-core detectors. (Z.S.) 4 refs.

23424 (INIS-mf–13503, pp. 221-224) **Operator aid systems under critical circumstances.** Perrot, J. (CEGELEC, Levallois-Perret (France)); Prud'homme, G. European Nuclear Society (ENS), Bern (Switzerland); Czech Nuclear Society, Prague (Czech Republic); Slovak Nuclear Society, Bratislava (Slovakia). Jan 1993. (CONF-921068–: East-West topical meeting: the safe and reliable operation of light water reactor NPP's, Prague (Czechoslovakia), 18-21 Oct 1992). In *Topform '92: the safe and reliable operation of LWR NPPs. Vol. II: Poster papers.* [245p.] Order Number DE93625345. Source: OSTI; NTIS (US Sales Only); INIS.

Under the leadership of the Nuclear Regulatory Commission, design criteria for operator information in control rooms were issued and were made mandatory for all nuclear plants in the United States. The main criteria are given in nuclear regulation (NUREG) document 696 regarding the safety parameter display system (SPDS), and in NUREG 0654 regarding the radiological release and dose assessment display (RRDAD). Subsequently information display systems were added or complemented to the safety assessment. In 1990, CEGELEC together with the Korean Company Hyundai Electronic Industries was chosen to implement such a system on each of the eight PWR units under operation. The systems, called Operator Aid Computer Systems (OACS) for the Korean project under way, are already partly delivered and will be fully commissioned in 1993. The four groups of functions provided by OACS are described, i.e., those related to supervision, to SPDS, RRAD and other functions. The main characteristics of the system are given. (Z.S.).

23425 (INIS-mf–13503, pp. 225-228) **A new advanced software platform for nuclear power plant process information systems.** Sorsa, A. (ABB Stromberg Power Ltd., Helsinki (Finland). Control Systems Division). European Nuclear Society (ENS), Bern

(Switzerland); Czech Nuclear Society, Prague (Czech Republic); Slovak Nuclear Society, Bratislava (Slovakia). Jan 1993. (CONF-921068–: East-West topical meeting: the safe and reliable operation of light water reactor NPP's, Prague (Czechoslovakia), 18-21 Oct 1992). In *Topform '92: the safe and reliable operation of LWR NPPs. Vol. II: Poster papers.* [245p.] Order Number DE93625345. Source: OSTI; NTIS (US Sales Only); INIS.

In the late 80s, ABB Stromberg Power Ltd. started the development of a new generation software platform for the power plant Process Information System (PIS). This development resulted in a software platform called Procontrol PMS. Procontrol PMS is a platform for fully distributed systems which provides the following features: distributed data processing, non-stop architecture, low-cost incremental expansion path, open network architecture, high functionality, effective application development environment, and advanced user interface services. A description of the structure of the Procontrol PMS software is given. ABB has received by May 1992 six orders for nuclear power plant PISs based on Procontrol PMS (4 for PWR plants, 2 for BWRs). The first Procontrol PMS based nuclear power plant PIS was commissioned in 1989 at the Loviisa nuclear power plant and has been running with 100% availability since the commissioning. (Z.S.) 2 figs.

23426 (INIS-mf–13503, pp. 229-232) **A new diagnostic concept for the primary circuit of WWER 1000 reactors.** Streicher, V. (Siemens AG, Erlangen (Germany)); Liska, J. European Nuclear Society (ENS), Bern (Switzerland); Czech Nuclear Society, Prague (Czech Republic); Slovak Nuclear Society, Bratislava (Slovakia). Jan 1993. (CONF-921068–: East-West topical meeting: the safe and reliable operation of light water reactor NPP's, Prague (Czechoslovakia), 18-21 Oct 1992). In *Topform '92: the safe and reliable operation of LWR NPPs. Vol. II: Poster papers.* [245p.] Order Number DE93625345. Source: OSTI; NTIS (US Sales Only); INIS.

The new concept developed by the Skoda and Siemens companies is based on their own experience, the requirements of the Czech Power Board/NPP Temelin Diagnostic Department, and on the research work of various institutes in Czechoslovakia. The development of a complex diagnostic concept is an iterative process and includes parts with different stages of experience and different goals. They can be divided into five groups: PC-based diagnostic systems with continuous or periodic functions, equipment for condition monitoring, PC-based data collectors, studies, analyses and measures which are mandatory for the correct performance and interpretation of the diagnostic systems, and the integration of all subsystems and data acquisition/evaluation units into a Local Area Network with a graphic workstation. (Z.S.) 2 figs., 4 refs.

23427 (INIS-mf–13503, pp. 233-237) **Computer systems in the operation, maintenance and technical support of Loviisa NPS.** Tiitinen, M. (Imatran Voima Oy, Loviisa (Finland). Loviisa NPS). European Nuclear Society (ENS), Bern (Switzerland); Czech Nuclear Society, Prague (Czech Republic); Slovak Nuclear Society, Bratislava (Slovakia). Jan 1993. (CONF-921068–: East-West topical meeting: the safe and reliable operation of light water reactor NPP's, Prague (Czechoslovakia), 18-21 Oct 1992). In *Topform '92: the safe and reliable operation of LWR NPPs. Vol. II: Poster papers.* [245p.] Order Number DE93625345. Source: OSTI; NTIS (US Sales Only); INIS.

A description is given of how the Loviisa nuclear power plant has utilized computers in many ways in the operation, maintenance, technical support and in other functions at the plant. The evolution of the computer system can be divided into the following phases: plant commissioning (1975-80), maintenance systems development (1981-84), second generation systems take-over (1985-90) and workstation client/server systems and PC's proliferation (1991->). A short description is given of the main systems at the Loviisa plant using computers, i.e. process computer systems, the plant information system, training simulator, vibration monitoring, laboratory computer systems, PC and workstation applications. (Z.S.) 4 refs.

23428 (JAERI-M–93-008) **Analysis of ROSA-IV/LSTF experiment simulating the Mihama Unit-2 steam generator U-tube rupture incident by using RELAP5/MOD2 code.** Watanabe, Tadashi (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Tokai Research Establishment); Kukita, Yutaka. Japan Atomic Energy Research Inst., Tokyo (Japan). Feb 1993. 28p. (In Japanese). Order Number DE93797597. Source: OSTI; NTIS; INIS.

The analysis of the ROSA-IV/LSTF experiment, Run SB-SG-06, simulating the Mihama Unit-2 steam generator tube rupture (SGTR) incident was performed by using the RELAP5/MOD2 code. The objectives of the analysis are to assess the code and the input data for SGTR experiment analyses, and to evaluate the predictive capability of the code for the characteristic phenomena in SGTR incidents. Major transient parameters including break flow rate, primary pressure, fluid temperatures and natural circulation flow rates, were predicted very well, while the SG secondary side liquid levels and pressure increase in the broken SG secondary sides were overestimated. These are probably due to a relatively rough noding in the SG secondary side used in the analysis and to the limitation in the vertical stratification model of the code. The steam in the pressurizer was found in the analysis to penetrate into the hot leg after loss of pressurizer liquid level, as was observed in the experiment. The void fraction in the hot leg was, however, underestimated. The flow regime in the hot leg during this period was bubbly, and the stratified flow seen in the experiment was not calculated. This is because the calculated steam velocity in the hot leg was larger than the criterion for the horizontal stratification. (author).

23429 (KFKI–1992-17/G) **'Kazmer' a complex noise diagnostic system for 1000 MWe PWR WWER type nuclear power units.** Por, G. (Hungarian Academy of Sciences, Budapest (Hungary). Central Research Inst. for Physics); Sokolov, L.A. Hungarian Academy of Sciences, Budapest (Hungary). Central Research Inst. for Physics. Jun 1992. [19p.] Order Number DE93626268. Source: OSTI; NTIS (US Sales Only); INIS.

Noise diagnostic systems have previously been developed and installed for the WWER-440 type reactors at the Paks Nuclear Power Plant, Hungary. Based on the experiences, the system has been extended and modified for use in 1000 MWe, WWER-1000 type units. KAZMER consists of three subsystem, the KARD reactor noise diagnostic system, ARGUS vibration monitoring system for rotation machinery, and ALMOS acoustic monitoring system. The installation of the KAZMER system at the Kalinin Nuclear Power Station, Russia, and the first operational experiences are outlined. (R.P.) 15 refs.; 9 figs.

23430 (NUREG–1474) **Effect of Hurricane Andrew on the Turkey Point Nuclear Generating Station from August 20–30, 1992: [Final report].** Hebdon, F.J. (Institute of Nuclear Power Operations, Atlanta, GA (United States)). Nuclear Regulatory Commission, Washington, DC (United States). Office for Analysis and Evaluation of Operational Data; Institute of Nuclear Power Operations, Atlanta, GA (United States). Mar 1993. 201p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). Source: OSTI; NTIS; INIS; GPO.

On August 24, 1992, Hurricane Andrew, a Category 4 hurricane, struck the Turkey Point Electrical Generating Station with sustained winds of 145 mph (233 km/h). This is the report of the team that the US Nuclear Regulatory Commission (NRC) and the Institute of Nuclear Power Operations (INPO) jointly sponsored (1) to review the damage that the hurricane caused the nuclear units and the utility's actions to prepare for the storm and recover from it, and (2) to compile lessons that might benefit other nuclear reactor facilities.

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Refer also to citation(s) 23468, 23597, 23622, 23623, 23624, 23640, 23641, 24016, 24018, 24019, 24020, 24021, 24026, 24028, 24030, 24031, 24039, 24076, 24871

23431 (IAEA-TECDOC–690, pp. 70-78) **Evaluations of the fracture mechanical properties of fuel compacts for the HTTR, with emphasis on thermal shock resistances and neutron irradiation effects.** Sato, S. (Ibaraki Univ., Hitachi (Japan). Faculty of Engineering); Kurumada, A.; Kawamata, K.; Suzuki, N.; Kaneko, M.; Fukuda, K. International Atomic Energy Agency, Vienna (Austria). Feb 1993. (CONF-9109266–: International Atomic Energy

Agency (IAEA) specialists meeting on status of graphite development for gas-cooled reactors, Tokai (Japan), 9-12 Sep 1991). In *The status of graphite development for gas cooled reactors: Proceedings of a specialists' meeting held in Tokai, Japan, 9-12 September 1991.* [311p.] Order Number DE93625195. Source: OSTI; NTIS (US Sales Only); INIS.

The High Temperature Engineering Testing Reactor (HTTR), currently under development by Japan Atomic Energy Research Institute (JAERI), uses fuel rods, which contain so called "fuel compact" of pellets and a form of fuel made by sintering coated UO_2 fuel kernel dispersed in natural graphite matrix in graphite sleeves. The spherical UO_2 fuel kernel in the fuel compact is covered with several layers of carbon and SiC. The primary objective of this study was to investigate the mechanical, fracture mechanics properties and the thermal shock resistances of the fuel compact. Disk or rod-shaped fuel compact specimens were prepared by using SiC-kernel coated particles instead of UO_2 particles, and by following otherwise the same manufacturing process as that for the real fuel compact. A series of experimental studies were then carried out by using these model specimens. These model specimens were further neutron irradiated in JMTR for fluences up to $1.7x10^{21}$ n/cm^2 (E<29fJ) at high temperature (900 deg. C ($\pm$ 50 deg. C)) to study the effects of neutron irradiation on the fracture mechanical properties. In this study, all the fratures were found to occur in the matrix or at the interfaces of kernel particles. No fracture of the SiC-kernel coated particles themselves was found. (author). 22 refs, 4 figs, 3 tabs, 5 photos.

23432 (IAEA-TECDOC–690, pp. 78-84) **A method for assessing the effects of graphite property variability on core structural integrity criteria.** Judge, R.C.B. (AEA Reactor Services, Risley (United Kingdom). Gas Cooled Reactor Assessments Dept.). International Atomic Energy Agency, Vienna (Austria). Feb 1993. (CONF-9109266–: International Atomic Energy Agency (IAEA) specialists meeting on status of graphite development for gas-cooled reactors, Tokai (Japan), 9-12 Sep 1991). In *The status of graphite development for gas cooled reactors: Proceedings of a specialists' meeting held in Tokai, Japan, 9-12 September 1991.* [311p.] Order Number DE93625195. Source: OSTI; NTIS (US Sales Only); INIS.

The Reserve Strength Factor (RSF) is the factor of safety used in assessments of Advanced Gas-cooled Reactor core integrity. Values of RSF currently used are based on engineering judgement. These values should, in principle, be related to variability due to inhomogeneity of graphite, systematic error in the calculation route and uncertainties in property measurement. A probabilistic approach, bringing the safety assessment of the graphite core into line with other reactor components, is described in this paper. A probability distribution for the RSF may be obtained by repeatedly following the full calculation route. In each iteration, appropriate values for the key parameters will be obtained using the Latin Hypercube sampling technique. The number of key parameters will be kept to a minimum by first using the sensitivity calculations to eliminate the less important ones. Material properties have generally been obtained from tests on small specimens. The variability in these properties would, intuitively, be expected to be greater than that found in the brick (on which the RSF calculations are based). In the case of non-destructive properties these size effects may be treated by applying the central limit theorem. Core brick strength will be obtained from a series of on-going experiments. The statistical distribution of brick strength will be assumed to follow a Weibull function fitted to small specimen data. Work is currently underway, applying this proposed methodology to an Advanced Gas-cooled Reactor core. (author). 6 refs.

23433 (IAEA-TECDOC–690, pp. 87-95) **Bending fatigue behavior of nuclear-grade graphite under impact loading.** Futakawa, M. (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Dept. of High Temperature Engineering); Kikuchi, K.; Muto, Y.; Shibata, H. International Atomic Energy Agency, Vienna (Austria). Feb 1993. (CONF-9109266–: International Atomic Energy Agency (IAEA) specialists meeting on status of graphite development for gas-cooled reactors, Tokai (Japan), 9-12 Sep 1991). In *The status of graphite development for gas cooled reactors: Proceedings of a specialists' meeting held in Tokai, Japan, 9-12 September 1991.* [311p.] Order Number DE93625195. Source: OSTI; NTIS (US Sales Only); INIS.

The graphite components in HTR (High Temperature gas-cooled Reactor) are subjected to impact force due to an earthquake. It is important from the viewpoint of seismic safety design to investigate the difference of strength under impact loading and non-impact loading. Both bending strength and bending fatigue strength tests, therefore, were carried out under impact non-impact loading on two kinds of graphite materials: isotropic and near-isotropic. The impact of response analyses, which used a beam model taking account of the contact behavior between specimen and tup, were performed to evaluate the relationships between impact energy, impact force and stress. The main conclusions obtained are summarized as follows: (1) A beam model taking account of the contact behavior through the Hertzian theory is applicable to describe the impact behavior. (2) The bending strength of graphite is independent of strain rate in the range from 10^{-6} to 5 l/s. (3) Despite both specimen volume and kind of graphite the strength of graphite is lower in impact fatigue than in non-impact fatigue. (author). 10 refs, 16 figs, 2 tabs.

23434 (IAEA-TECDOC–690, pp. 95-105) **Component test of the core support post of the HTTR.** Ishihara, M. (Japan Atomic Energy Research Inst., Oarai, Ibaraki (Japan). Oarai Research Establishment); Iyoku, T.; Takikawa, N.; Shiozawa, S.; Jinza, K.; Tsuji, N.; Miki, T. International Atomic Energy Agency, Vienna (Austria). Feb 1993. (CONF-9109266–: International Atomic Energy Agency (IAEA) specialists meeting on status of graphite development for gas-cooled reactors, Tokai (Japan), 9-12 Sep 1991). In *The status of graphite development for gas cooled reactors: Proceedings of a specialists' meeting held in Tokai, Japan, 9-12 September 1991.* [311p.] Order Number DE93625195. Source: OSTI; NTIS (US Sales Only); INIS.

The component test of core support post for the High Temperature Engineering Test Reactor (HTTR) was carried out to verify its structural integrity using full-scale and 1/2-scale models of core support post and seat. The compressive fracture load (buckling load) of support post was measured under the conditions of post inclination angles to the post axis up to about 1 degree, cyclic load above maximum applied load and oxidation weight loss under about 30% at room temperature. In the cyclic load test, compressive fracture load was also measured after 200 times of cyclic load applied; the magnitude of this cyclic load was about 2.5 times of the maximum applied load in the design of HTTR. In this report the effects of compressive fracture load on post inclination angle, cyclic load and oxidation weight loss of this component were discussed and obtained fracture loads were compared with the applied load in the design of HTTR. (author). 4 refs, 13 figs, 2 tabs.

23435 (IAEA-TECDOC–690, pp. 105-112) **Assessment of the load capacity of the dowel and socket system in the HTTR hexagonal block.** Takikawa, N. (Japan Atomic Energy Research Inst., Oarai, Ibaraki (Japan). Oarai Research Establishment); Ishihara, M.; Iyoku, T.; Shiozawa, S.; Tokumitsu, M.; Koe, S.; Uno, M. International Atomic Energy Agency, Vienna (Austria). Feb 1993. (CONF-9109266–: International Atomic Energy Agency (IAEA) specialists meeting on status of graphite development for gas-cooled reactors, Tokai (Japan), 9-12 Sep 1991). In *The status of graphite development for gas cooled reactors: Proceedings of a specialists' meeting held in Tokai, Japan, 9-12 September 1991.* [311p.] Order Number DE93625195. Source: OSTI; NTIS (US Sales Only); INIS.

The load capacity of the dowel and socket system was demonstrated in the seismic event using full size graphite blocks and finite element analysis. There was good agreement between the measured fracture stress and the calculated fracture stress. This shows the propriety of 3D FEM modeling in which analytical mesh, quoted data and boundary condition were involved. A special method was also developed for the dowel and socket system. It can estimate the stress of full 3D model from the stresses of 1/3 model. (author). 2 refs, 8 figs, 3 tabs.

23436 (IAEA-TECDOC–690, pp. 113-120) **The vibrational characteristics of the keyed graphite components in the HTTR.** Futakawa, M. (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Tokai Research Establishment); Iyoku, T.; Shiozawa, S.; Takada, S.; Shirai, H. International Atomic Energy Agency, Vienna (Austria). Feb 1993. (CONF-9109266–: International Atomic

Energy Agency (IAEA) specialists meeting on status of graphite development for gas-cooled reactors, Tokai (Japan), 9-12 Sep 1991). In *The status of graphite development for gas cooled reactors: Proceedings of a specialists' meeting held in Tokai, Japan, 9-12 September 1991.* [311p.] Order Number DE93625195. Source: OSTI; NTIS (US Sales Only); INIS.

The assembly system consisting of the keyed graphite components, which is employed in the core bottom structure of the HTTR (High Temperature Engineering Test Reactor), has a nonlinear vibrational characteristic. The analytical code was developed to predict the vibrational characteristic, and the validity of the code was verified through seismic model tests. (author). 3 refs, 12 figs.

23437 (IAEA-TECDOC–690, pp. 195-199) **Engineering thermomechanics of nuclear graphites under neutron irradiation, oxidation and transient heatup: A review.** Arai, T. (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Tokai Research Establishment). International Atomic Energy Agency, Vienna (Austria). Feb 1993. (CONF-9109266–: International Atomic Energy Agency (IAEA) specialists meeting on status of graphite development for gas-cooled reactors, Tokai (Japan), 9-12 Sep 1991). In *The status of graphite development for gas cooled reactors: Proceedings of a specialists' meeting held in Tokai, Japan, 9-12 September 1991.* [311p.] Order Number DE93625195. Source: OSTI; NTIS (US Sales Only); INIS.

Structural assessment of a GCR graphite component involves thermal and stress/strain calculations to determine local stress states. These analyses require data base and predictive models on thermomechanical behavior of graphite materials. The paper reviews state-of-the-art of graphite technology on thermomechanics with emphasis on nonisothermal irradiation, nonuniform oxidation and post-irradiation annealing. Relevant data base and predictive models are discussed. Nonisothermal irradiation behavior have now been handled partly by use of the Graphite Damage Model. Further verification of the methodology is being attempted. Some data base and analyses on deformation behavior of nonuniformly oxidized specimens are available. A few experimental evidences suggest that among various thermomechanical properties thermal conductivity should influence transient heatups after irradiations. Current knowledge and additional key data may be coordinated with a further sophistication of descriptive models for better performance and reliable operation of graphite components in actual reactors. (author). 30 refs, 1 fig., 4 tabs.

23438 (IAEA-TECDOC–690, pp. 200-204) **A review of irradiation creep in reactor graphite.** Kelly, B.T. (AEA Technology, Salwick (United Kingdom)). International Atomic Energy Agency, Vienna (Austria). Feb 1993. (CONF-9109266–: International Atomic Energy Agency (IAEA) specialists meeting on status of graphite development for gas-cooled reactors, Tokai (Japan), 9-12 Sep 1991). In *The status of graphite development for gas cooled reactors: Proceedings of a specialists' meeting held in Tokai, Japan, 9-12 September 1991.* [311p.] Order Number DE93625195. Source: OSTI; NTIS (US Sales Only); INIS.

The construction of graphite moderated reactors with extended lives would be virtually impossible but for the existence of irradiation creep which relaxes stresses within components due to gradients of irradiation damage which would otherwise produce failure. A very large amount of experimental data exists on many types of graphite, but there are still important differences in the constitutive equations derived by different groups and applied to calculate brick stresses. This paper summarizes the results of a review of knowledge of irradiation creep recently carried out in the United Kingdom. (author). 8 refs, 3 figs, 1 tab.

23439 (IAEA-TECDOC–690, pp. 205-209) **Specific behavior of reflector and matrix graphite under high temperature irradiation.** Platonov, P.A. (I.V. Kurchatov Inst. of Atomic Energy, Moscow (Russian Federation). Dept. of Research Reactors and Technology); Karpukhin, V.I.; Shtrombakh, Ya.I.; Alekseev, V.M.; Chugunov, O.K.; Gurovich, B.A.; Trofimchuk, E.I. International Atomic Energy Agency, Vienna (Austria). Feb 1993. (CONF-9109266–: International Atomic Energy Agency (IAEA) specialists meeting on status of graphite development for gas-cooled reactors, Tokai (Japan), 9-12 Sep 1991). In *The status of graphite development for gas cooled reactors: Proceedings of a specialists' meeting held in Tokai, Japan, 9-12 September 1991.* [311p.] Order Number DE93625195. Source: OSTI; NTIS (US Sales Only); INIS.

Physical properties for reflector and matrix graphite for the VG-400 VGM reactors being developed in the USSR are reported. Three types of graphite have been investigated. These are: the graphite based on uncalcinated coke - KPG and MPC; the graphite based on the special coke - GR1; and the graphite for spherical fuel elements - molded graphite (KPD) and graphite binded by pyrocarbon (GSP). Specimens of these graphites have been irradiated up to a neutron fluence of 0.5 to 2.5×10^{22} neutron/cm^2. The dependence of the following on fluence is reported: relative volume change, Young's modulus, dimensional change, elastic modulus, electrical resistivity, thermal conductivity and the coefficient of thermal expansion. (author). 3 refs, 10 figs, 2 tabs.

23440 (IAEA-TECDOC–690, pp. 210-219) **Irradiation behavior of boronated graphite for the HTTR.** Matsuo, H. (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Tokai Research Establishment); Kobayashi, F.; Sawa, K. International Atomic Energy Agency, Vienna (Austria). Feb 1993. (CONF-9109266–: International Atomic Energy Agency (IAEA) specialists meeting on status of graphite development for gas-cooled reactors, Tokai (Japan), 9-12 Sep 1991). In *The status of graphite development for gas cooled reactors: Proceedings of a specialists' meeting held in Tokai, Japan, 9-12 September 1991.* [311p.] Order Number DE93625195. Source: OSTI; NTIS (US Sales Only); INIS.

Two kinds of hot-pressed and cold-pressed boronated graphites containing 3 wt% or 30 wt% boron for use in the HTTR were studied. Neutron-irradiation was done up to a maximum fast neutron fluence 2×10^{25}n/m^2 (E>29fJ) at 550-1070 deg. C in the JMTR. Irradiation-induced dimensional changes, thermal expansivity and thermal conductivity from room temperature to high temperatures were measured after the irradiation. Dimensional changes and thermal expansivity depend on the direction measured and fabrication method, and thermal conductivity decreased and its temperature dependence changed after the irradiation. Furthermore the changes depend on boron content as well. (author). 7 refs, 12 figs, 1 tab.

23441 (IAEA-TECDOC–690, pp. 225-230) **Strength analysis code for graphite structural components in uranium-graphite nuclear reactors.** Rodchenkov, B.S. (Research and Development Inst. of Power Engineering (Russian Federation)); Platonov, P.A.; Manevskij, V.N.; Kashirin, B.A.; Chugunov, O.K. International Atomic Energy Agency, Vienna (Austria). Feb 1993. (CONF-9109266–: International Atomic Energy Agency (IAEA) specialists meeting on status of graphite development for gas-cooled reactors, Tokai (Japan), 9-12 Sep 1991). In *The status of graphite development for gas cooled reactors: Proceedings of a specialists' meeting held in Tokai, Japan, 9-12 September 1991.* [311p.] Order Number DE93625195. Source: OSTI; NTIS (US Sales Only); INIS.

The Strength Analysis Code for graphite components used in uranium-graphite channel-type reactors has been developed in the USSR on the basis of results of reactor graphite property investigations including its properties under neutron irradiation conditions as well as on the operating experience of graphite structural components in the uranium-graphite reactors. The graphite stack forms the basis for the uranium-graphite reactor design. The strength analysis of the graphite components are performed following the physics and thermal physics calculations needed to assess thermal and radiation stresses in the analyzed components as well as following the account of variations in physics and mechanical properties of graphite under neutron irradiation and temperature. Strength analysis principles in the code are based on limiting states determined for achievement of critical fluence, crack formation under static loading, accumulation of ultimate strain, and initiation of through crack under static and cyclic loading. Each of these is discussed in the paper. (author). 3 refs, 1 fig., 1 tab.

23442 (IAEA-TECDOC–690, pp. 265-272) **Radiolytic corrosion of graphite surveillance and lessons drawn from the operation of the BUGEY-1 reactor.** Petit, A. (Electricite de France (EDF), 01 - Loyettes (France). Centrale de Bugey); Phalippou, C.; Brie, M. International Atomic Energy Agency, Vienna (Austria). Feb 1993. (CONF-9109266–: International Atomic Energy Agency (IAEA) specialists meeting on status of graphite development for gas-cooled reactors, Tokai (Japan), 9-12 Sep 1991). In *The status*

of graphite development for gas cooled reactors: Proceedings of a specialists' meeting held in Tokai, Japan, 9-12 September 1991. [311p.] Order Number DE93625195. Source: OSTI; NTIS (US Sales Only); INIS.

This document briefly describes some of the feedback of experience from operation of the BUGEY-1 reactor. There is a major radiolytic corrosion problem with the graphite of the stack of this reactor and small quantities of methane are added to the coolant gas to limit its effect. Inhibition with methane has the drawback of resulting in hydrocarbon deposits forming on the fuel elements, which makes it necessary to periodically eliminate them by injecting oxygen. The amount of weight loss is determined by annually taking core samples from the channel walls. Additional examinations are made, on completing each core drilling session, of the core samples with the highest corrosion factors: determination of the density profiles (and verification of weight loss) by gamma ray absorption; measurement of the compressive strength (perpendicularly to the channel wall); hydrogen analysis (on a few samples). Identical examinations are made on samples taken for the purpose parallel to the channel wall. 10 refs, 6 diagrams.

23443 (IAEA-TECDOC–690, pp. 273-280) **Graphite surveillance in N Reactor.** Woodruff, E.M. (Westinghouse Hanford Co., Richland, WA (United States). N Reactor Facility and Operation Assurance). International Atomic Energy Agency, Vienna (Austria). Feb 1993. Contract DE-ACU6-87RL10930. (CONF-9109266–: International Atomic Energy Agency (IAEA) specialists meeting on status of graphite development for gas-cooled reactors, Tokai (Japan), 9-12 Sep 1991). In *The status of graphite development for gas cooled reactors: Proceedings of a specialists' meeting held in Tokai, Japan, 9-12 September 1991.* [311p.] Order Number DE93625195. Source: OSTI; NTIS (US Sales Only); INIS.

Graphite dimensional changes in N Reactor during its 24 yr operating history are reviewed. Test irradiation results, block measurements, stack profiles, top of reflector motion monitors, and visual observation of distortion are described. (author). 18 refs, 14 figs.

23444 (IAEA-TECDOC–690, pp. 281-288) **Non-destructive testing and acceptance test for HTTR graphite components.** Takikawa, N. (Japan Atomic Energy Research Inst., Oarai, Ibaraki (Japan). Oarai Research Establishment); Iyoku, T.; Shiozawa, S.; Ooka, N.; Kambe, M.; Ide, A. International Atomic Energy Agency, Vienna (Austria). Feb 1993. (CONF-9109266–: International Atomic Energy Agency (IAEA) specialists meeting on status of graphite development for gas-cooled reactors, Tokai (Japan), 9-12 Sep 1991). In *The status of graphite development for gas cooled reactors: Proceedings of a specialists' meeting held in Tokai, Japan, 9-12 September 1991.* [311p.] Order Number DE93625195. Source: OSTI; NTIS (US Sales Only); INIS.

The HTTR core is an array of hexagonal graphite blocks. It is supported by graphite core support structures and permanent side reflector blocks. The structural integrity of these graphite components is assured by the detail mechanical design and the acceptance test to guarantee the design. The acceptance test is planned for the graphite components as follows. (1) Material identification tests: To identify the graphite grade of received materials. (2) Impurity tests: To limit impurities to the level specified by the nuclear and shielding designs. (3) Strength tests: To guarantee the strength of received materials. (4) Non-destructive tests: To eliminate components with harmful flaws in them. To achieve the 4 objectives, ultrasonic and eddy current tests were selected for internal and surface flaw detection, respectively. Preliminary tests were carried out to obtain flaw detectability for the graphite grade used as a material of the HTTR components. (author). 3 figs, 7 tabs.

23445 (IAEA-TECDOC–690, pp. 291-298) **Non-destructive test of HTGR graphite components.** Ishihara, M. (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Dept. of High Temperature Engineering); Ishii, T.; Ishiyama, S.; Eto, M. International Atomic Energy Agency, Vienna (Austria). Feb 1993. (CONF-9109266–: International Atomic Energy Agency (IAEA) specialists meeting on status of graphite development for gas-cooled reactors, Tokai (Japan), 9-12 Sep 1991). In *The status of graphite development for gas cooled reactors: Proceedings of a specialists' meeting held in Tokai, Japan, 9-12 September 1991.* [311p.] Order Number DE93625195. Source: OSTI; NTIS (US Sales Only); INIS.

Prototype NDT model units for HTTR graphite components was constructed and optimizing regulation tests of eddy-current Nondestructive Test (NDT) units and NDT for drill hole on the surface of plates made of IG-110 and PGX graphites were carried out. From those test results, the following conclusions were derived: (1) Recommendable probe-testing material distance (lift-off) and scanning speed for the evaluation of diameter of drill hole on the surface of graphite plates are within 0.1mm to 0.3mm and 25mm/s to 30mm/s respectively, however, for the evaluation of depth of drill hole, more than 30mm/s scanning speed should be chosen. (2) Measurable minimum diameter and maximum depth of drill hole measured by C-scan technique were 2mm and 3mm on the surface of IG-110 and PGX graphite plates. (author). 1 ref., 18 figs, 1 tab.

23446 (INIS-mf–13503, pp. 170-173) **ABB engagement in efforts to improve the safety of RBMK reactors.** Tiren, L.I. (ABB Atom AB, Vaesteraas (Sweden)); Bioere, S.; Molin, J. European Nuclear Society (ENS), Bern (Switzerland); Czech Nuclear Society, Prague (Czech Republic); Slovak Nuclear Society, Bratislava (Slovakia). Jan 1993. (CONF-921068–: East-West topical meeting: the safe and reliable operation of light water reactor NPP's, Prague (Czechoslovakia), 18-21 Oct 1992). In *Topform '92: the safe and reliable operation of LWR NPPs. Vol. II: Poster papers.* [245p.] Order Number DE93625345. Source: OSTI; NTIS (US Sales Only); INIS.

ABB Atom is engaged in safety analysis for the Ignalinsk (RBMK) nuclear power plant. The analysis is done within the framework of two different initiatives of the Swedish Nuclear Power Inspectorate, namely: probabilistic safety assessment, i.e. the BARSELINA project, and analysis of containment safety issues. The aim is to enable decisions to be made for specific hardware modifications. The following items were considered by the Swedish Nuclear Power Inspectorate to be the most significant with regard to safety and were thus selected for further study or action: nondestructive testing of primary system components, fire and flooding protection, pressure relief from the reactor cavity in certain accident sequences, Accident Localization System improvements, and a separate auxiliary feedwater system. (Z.S.) 1 fig.

23447 (NUREG/CR–5984) **Code and model extensions of the THATCH code for modular high temperature gas-cooled reactors.** Kroger, P.G. (Brookhaven National Lab., Upton, NY (United States)); Kennett, R.J. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Systems Research; Brookhaven National Lab., Upton, NY (United States). May 1993. 37p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC02-76CH00016. (BNL-NUREG–52356). Source: OSTI; NTIS; INIS; GPO.

This report documents several model extensions and improvements of the THATCH code, a code to model thermal and fluid flow transients in High Temperature Gas-Cooled Reactors. A heat exchanger model was added, which can be used to represent the steam generator of the main Heat Transport System or the auxiliary Shutdown Cooling System. This addition permits the modeling of forced flow cooldown transients with the THATCH code. An enhanced upper head model, considering the actual conical and spherical shape of the upper plenum and reactor upper head was added, permitting more accurate modeling of the heat transfer in thisregion. The revised models are described, and the changes and addition to the input records are documented.

23448 (ORNL/FTR–4228) **Review Meeting for the Modular High-Temperature Gas-Cooled Reactor Corrosion, Migration, et Distribution Irradiation Experiment Fission Product Transport Program in France: Foreign trip report, March 26, 1992–April 5, 1992.** Kimball, O.F. Oak Ridge National Lab., TN (United States). 22 Apr 1992. 33p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93011289. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The COMEDIE loop is an engineering-scale experimental loop that will be operated in the SILOE reactor pool at CENG to obtain an independent data base that can be used to validate MHTGR fission product transport codes. Testing will be done under representative MHTGR conditions with representative components.

Designed-to-fail (DTF) fuel particles, under irradiation, will release fission products that will be transported and distributed through the fuel block, a graphite block representing the lower reflector element, and a gas/gas heat exchanger representing the metallic surfaces in the primary circuit of an MHTGR. A depressurization section in the loop produces blowdowns simulating possible depressurization events. The primary purpose of this visit to the CENG was to review the technical and programmatic issues associated with French safety authorities' concerns about the COMEDIE loop that have caused several months' delay in starting the first irradiation test. A secondary purpose was to complete preparations for the start of this test, now expected to be in June or August 1992.

23449 (ORNL/FTR–4456) **[International Atomic Energy Agency's gas-cooled reactor technology development activities]: Foreign trip report, April 19, 1991–November 4, 1992.** Cleveland, J.C. Oak Ridge National Lab., TN (United States). 6 Nov 1992. 58p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93009934. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report describes travel to coordinate the International Atomic Energy Agency's Gas-cooled Reactor technology development activities (April 25, 1991–October 23, 1992) on a temporary foreign assignment to the IAEA, and to participate in a technical review of the MHTGR Fission Product Transport Program at Centre d'Etudes Nucleaire, Grenoble, France (April 22–23, 1991).

2104 Power Reactors, Nonbreeding, Otherwise Moderated Or Unmoderated

Refer also to citation(s) 23621, 23645

23450 (IAEA-TECDOC–690, pp. 169-176) **Corrosion behavior of sintered pellet of graphite and boron carbide in helium containing water vapor.** Fujii, K. (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Dept. of Fuels and Materials Research); Nomura, S.; Shindo, M.; Imai, H. International Atomic Energy Agency, Vienna (Austria). Feb 1993. (CONF-9109266–: International Atomic Energy Agency (IAEA) specialists meeting on status of graphite development for gas-cooled reactors, Tokai (Japan), 9-12 Sep 1991). In *The status of graphite development for gas cooled reactors: Proceedings of a specialists' meeting held in Tokai, Japan, 9-12 September 1991.* [311p.] Order Number DE93625195. Source: OSTI; NTIS (US Sales Only); INIS.

The corrosion test of the sintered pellet of graphite and boron carbide, which has been adopted as a neutron absorber material in the control rod system, the reserved shutdown system, etc. of the High Temperature Engineering Test Reactor (HTTR), was carried out in helium containing water vapor at up to 1000 deg. C from a viewpoint of oxidation of boron carbide (B_4C). Moreover, from the results obtained of the corrosion test, the integrity of the reserved shutdown system was also evaluated. It is shown that the oxidation rates of the sintered pellet simply do not increase with temperature caused by the formation of B_2O_3. The oxidation reaction of the sintered pellet consists of three competing reactions: $B_4C+6H_2O=2B_2O_3+6H_2+C(F)$ first step; $C(F)+H_2O=CO+H_2$ and $C(G)+H_2O=CO+H_2$ second step. For the integrity of the reserved shutdown system, the mutual adhesion of the sintered pellets is one of the key factors because the sintered pellets mutually adhered may not be inserted into the core in an emergency. For the sintered pellet containing 30% B, which is the same B concentration as the specification of the sintered pellet adopted in the reserved shutdown system, mutual adhesion yields in such a case about 2% if the contained B is oxidized and the temperature exceeds 577 deg. C, which is the melting point of B_2O_3. There is no possibility of both conditions yielding in the HTTR, therefore it can be concluded that the integrity of the reserved shutdown system is not damaged against the corrosion. (author). 11 refs, 11 figs, 6 tabs.

23451 (INIS-mf–13503, pp. 100-103) **Experience of PSA based back-fitting.** Butcher, P. (AEA Technology, Winfrith (United Kingdom)); Debenham, A.A.; Holloway, N.J. European Nuclear Society (ENS), Bern (Switzerland); Czech Nuclear Society, Prague (Czech Republic); Slovak Nuclear Society, Bratislava (Slovakia). Jan 1993. (CONF-921068–: East-West topical meeting: the safe and reliable operation of light water reactor NPP's, Prague (Czechoslovakia), 18-21 Oct 1992). In *Topform '92: the safe and reliable operation of LWR NPPs. Vol. II: Poster papers.* [245p.] Order Number DE93625345. Source: OSTI; NTIS (US Sales Only); INIS.

AEA Technology has carried out a level 3 Probabilistic Safety Analysis (PSA) of the SGHWR reactor located at Winfrith. The PSA was used to identify the most effective potential back-fits for further improving the safety of the plant. Cost effectiveness was a significant factor in deciding the preferable options. A brief description of the reactor is given, and the accident sequences which dominate the risk from the plant are listed. The proposed hardware and procedural back-fits are discussed. Simple and cost effective hardware modifications, combined with improved accident management procedures, provided the greatest improvements in the assessed safety of the plant. (Z.S.) 4 figs.

23452 (KFKI–1992-19/G,I) **Acoustic emission experiments for PHWR technology development.** Pellionisz, P. (Hungarian Academy of Sciences, Budapest (Hungary). Central Research Inst. for Physics); Jha, S.K.; Goswami, G.L. Hungarian Academy of Sciences, Budapest (Hungary). Central Research Inst. for Physics. Jun 1992. [21p.] Order Number DE93626294. Source: OSTI; NTIS (US Sales Only); INIS.

An Indian-Hungarian joint research project has been started with the aim of applying acoustic emission testing to solve specific problems of nuclear power plants. Acoustic emission measurement and analyzing instrumentation and software have been provided by the Hungarian side, while the measurements have been performed at the Bhabha Atomic Research Centre (BARC), India. The first task of the project was to check the capability of the method for leakage detection and shuttle movement monitoring of Pressurized Heavy Water Reactors (PHWR), and for monitoring manufacturing processes as laser welding. The preliminary measurements and results are presented. (R.P.) 15 refs.; 11 figs.; 3 tabs.

23453 (SAND–91-2383) **Scoping studies of boiling phenomena associated with the flooded cavity design of the Heavy Water New Production Reactor.** Chu, T.Y.; Dykhuizen, R.C.; Hickox, C.E. Sandia National Labs., Albuquerque, NM (United States). Mar 1993. 128p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (NPRW-SA–91-7). Order Number DE93013963. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The proposed Ebasco Heavy Water New Production Reactor (NPR-HWR) design incorporates a flooded reactor cavity as a design feature for accident mitigation. The downward heat transfer from the core-melt through the reactor vessel is expected to be balanced by boiling heat transfer outside of the bottom head thus preventing melt-through of the reactor vessel. The report presents results of scoping studies to examine the boiling phenomena associated with the flooded cavity design. Relevant literature of boiling from downward-facing surfaces is reviewed and the scaling parameters of the problem are examined. In addition, approximate analyses are performed to obtain a quantitative appreciation of the problem and help to determine correlation groups with which to examine future experimental data.

23454 (WSRC-TR–92-357) **Type Q septifoil guide tube freeboard: Model description and results: Task Number: 92-057-1.** Shadday, M.A. (ed.). Westinghouse Savannah River Co., Aiken, SC (United States). Sep 1992. 87p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE93014721. Source: OSTI; NTIS; GPO Dep.

On May 25, 1992, a moderator leak was detected as partial length control rods in K Reactor were being positioned for reactor start up. The source of the leak was suspected to be overflow of the control rod guide tubes that are above the septifoils, though the cause was unknown. The control rods were re-inserted, and the process water pump AC drive motors were tripped. K Reactor start up was put on hold until the cause of the leak was understood, and rectified. Tests to determine the cause of the leak were initiated by the Heat Transfer Laboratory (HTL) that evening. On May 27, the cause of the overflow was identified from HTL tests. The overflow was caused by flow through the partial control rod extension tubes up into their guide tubes. When the top ends of the

partial length control rod extension tubes are drawn up into the guide tubes, the guide tubes are pressurized by the flow diverted through the extension tubes, and the freeboard in those guide tubes is reduced. This secondary flow path was not anticipated when the type Q septifoil was designed, and it was therefore not included in existing septifoil models. This report documents the development of a septifoil model that includes the various secondary flow paths, and predicts the freeboards in the guide tubes, as functions of the control rod positions, the blanket gas pressure, and the septifoil flow rate. The results of this model agree very well with HTL test results, and therefore reinforce confidence in the management decision to throttle septifoil flow to approximately 70 gpm, to prevent overflow of the septifoil guide tubes.

23455 (WSRC-TR–93-080) **Final report for the flow excursion follow-on testing.** Nash, C.A.; Walters, T.W. Westinghouse Savannah River Co., Aiken, SC (United States). 5 Aug 1992. 244p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE93013570. Source: OSTI; NTIS; INIS; GPO Dep.

The purpose of the Mark 22 Flow Excursion Follow-On testing was to investigate the theory that approximately 15% of the flow bypassed the primary flow channels in previous testing, whereas the design called for only a 3% bypass. The results of the follow-on tests clearly confirmed this theory. The testing was performed in two phases. During the first phase, characterization tests performed during the earlier test program were repeated.

2105 Power Reactors, Breeding

Refer also to citation(s) 22876, 22877, 22978, 23512, 23516, 23666

23456 (ANL/FC/CP–77824) **Determination of the shape of a plutonium deposit from a leaking crucible.** Solbrig, C.W.; Clarksean, R. Argonne National Lab., IL (United States). [1993]. 25p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-930352–15: 2. international conference on nuclear engineering, San Francisco, CA (United States), 21-24 Mar 1993). Order Number DE93009131. Source: OSTI; NTIS; INIS; GPO Dep.

An analytical model was developed which predicts that the leak rate (or drip rate) of molten plutonium onto a substrate must be low in order for plutonium to solidify into a problematical hemispherical shape. The heat transfer to the substrate is the significant factor in how quickly the fuel solidifies. Analysis and experiment show that for a given substrate, the deposit center height is independent of the leakrate. A good conductor, such as copper on the bottom of a fuel casting furnace, will conduct heat away quickly and tend to cause the fuel to form into a hemisphere. A good insulator on the other hand, will keepthe metal molten to allow it to spreads out and solidify as a flat disk. Higher substrate temperatures inhibit the undesirable hemispherical shape. Experiments conducted were in good agreement with the an analytical model.

23457 (ANL/OTD-ER/CP–79006) **Progress and status of the Integral Fast Reactor (IFR) fuel cycle development.** Till, C.E.; Chang, Y.I. Argonne National Lab., IL (United States). [1993]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-930433–6: 55. annual American power conference, Chicago, IL (United States), 13-15 Apr 1993). Order Number DE93009967. Source: OSTI; NTIS; INIS; GPO Dep.

The Integral Fast Reactor (IFR) fuel cycle holds promise for substantial improvements in economics, diversion-resistance, and waste management. This paper discusses technical features of the IFR fuel cycle, its technical progress, the development status, and the future plans and directions.

23458 (CEA-CONF–11279) **Tripoli 3: a Monte Carlo code with a powerful and automatic biasing.** Vergnaud, T.; Nimal, J.C.; Both, J.P. CEA Centre d'Etudes de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Mecanique et de Technologie. 1993. [10p.] (CONF-930404–: International topical meeting on mathematical methods and supercomputing in nuclear applications (M&C+SNA '93), Karlsruhe (Germany), 19-23 Apr 1993). Order Number DE93626295. Source: OSTI; NTIS (US Sales Only); INIS.

The TRIPOLI-3 program kept all the capabilities of the TRIPOLI-2 but offers many other possibilities. The most interesting is the automatization of the biasing which makes easier the user's work significantly. The visualization of the spatial and energetic distribution of particles during the simulation allows to check the biasing.

23459 (FEI–2140) **Temperature fields and coefficient of sodium turbulent temperature conductivity at fast reactor fuel assembly model outlet.** Zhukov, A.V.; Matyukhin, N.M.; Yur'ev, Yu.S.; Sanina, I.V. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk (Russian Federation). Fiziko-Ehnergeticheskij Inst. 1990. [10p.] (In Russian). Order Number DE93626296. Source: OSTI; NTIS (US Sales Only); INIS.

Temperature distributions by radius and height of the overassembly space were determined in experiments carried out with seven model subassemblies with external subassembly heating in the case of sodium flow rate variation. The essential equalization of temperature non-uniformity through the flow has been exposed. Exponential approximation of temperature distribution in axial direction as well as Bessel function approximation in radial direction enable to define the mean turbulent temperature diffusivity and its dependence on the Peclet number. 10 refs.; 8 figs.

23460 (FEI–2151) **On studying the reactor fuel element local temperatures under nonstationary conditions.** Mikhin, V.I.; Matyukhin, N.M.; Zhukov, A.V.; Fetisova, L.N. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk (Russian Federation). Fiziko-Ehnergeticheskij Inst. 1990. [19p.] (In Russian). Order Number DE93627421. Source: OSTI; NTIS (US Sales Only); INIS.

The results of numerical theoretical analysis of the possibility of modelling of the nonstationary temperature regimes in fast reactor fuel assemblies are presented. The conditions of approximate modelling of nonstationary heat transfer in fast reactor fuel assemblies are also presented. The investigation has been successful in rendering a number of typical nonstationary processes and in obtaining the data for the subsequent improvement of the method of temperature regime modelling in fast reactor fuel assemblies. 3 refs.; 15 figs. <GS>

23461 (JAERI-M–92-196) **Benchmark physics experiment of metallic-fueled LMFBR at FCA: Core design of FCA assembly XVI-1 and criticality.** Iijima, Susumu (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Tokai Research Establishment); Oigawa, Hiroyuki; Nakano, Masafumi; Bando, Masaru. Japan Atomic Energy Research Inst., Tokyo (Japan). Dec 1992. 38p. (In Japanese). Order Number DE93797512. Source: OSTI; NTIS; INIS.

A benchmark physics experiment of a metallic-fueled LMFBR was performed at Japan Atomic Energy Research Institute's Fast Critical Assembly (FCA) in order to examine availability of data and method for a design of metallic-fueled core. The nuclear data and the calculation methods used for a LMFBR core design have been improved based on the oxide fuel core experiments. A metallic-fueled core has a harder neutron spectrum than an oxide-fueled core and has typical nuclear characteristics affected by the neutron spectrum. In this study, availability of the conventional calculation method for the design of the metallic-fueled core was examined by comparing the calculation values of the nuclear characteristics with the measured values. The experimental core (FCA assembly XVI-1) was selected by referring to the conceptual design of Central Research Institute of Electric Power Industry. The calculated-to-experiment (C/E) value for k_{eff} of assembly XVI-1 was 1.001. From this, as far as the criticality the prediction accuracy of the conventional calculation for the metallic-fueled core was concluded to be similar to that of an oxide-fueled core. (author).

23462 (NIIAR–13-796) **Study on the influence of phase characteristics of the amplifier track on the errors for sodium flow rate measurements by correlation method.** Tokarev, A.Yu. Nauchno-Issledovatel'skij Inst. Atomnykh Reaktorov, Dimitrovgrad (Russian Federation). 1990. [12p.] (In Russian). Order Number DE93626297. Source: OSTI; NTIS (US Sales Only); INIS.

Methods for calculation of an error in determining the cross-correlation function peak position depending on the relative change of the nominal values of the amplifier track descrete components for sodium flow rate measurements by method are described. The

results of calculation experiments and relations obtained for low-frequency Chebyshev filters of the second order of magnitude in case of non-identity of the capacities in the feedback curcuit of the operational amplifiers, forming these filters are presented. 4 refs.; 5 figs.

23463 (WHC-SA–1602) **Status of fuel, blanket, and absorber testing in the Fast Flux Test Facility.** Baker, R.B.; Bard, F.E.; Leggett, R.D.; Pitner, A.L. Westinghouse Hanford Co., Richland, WA (United States). Nov 1992. 22p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. (CONF-921102–61: Joint American Nuclear Society (ANS)/European Nuclear Society (ENS) international meeting on fifty years of controlled nuclear chain reaction: past, present, and future, Chicago, IL (United States), 15-20 Nov 1992). Order Number DE93014187. Source: OSTI; NTIS; INIS; GPO Dep.

Over 67,000 fuel, blanket and absorber pins have been irradiated in the Fast Flux Test Facility (FFTF) during its first 12 years of operation. Tests are run in highly controlled and monitored environments with core components similar in size to those in commercial liquid metal reactor (LMR) designs. While primary emphasis was placed on mixed oxide fuels, significant development programs have included metallic fuels, UO_2 blankets, B_4C absorbers, and other fuels and materials of interest. Irradiation programs for mixed oxides have included progressively lower swelling cladding and duct alloys (e.g., 316 SS, D9 SS, and the ferritic HT9), which also have application to other core components. In many instances the current exposure levels of the advanced FFTF tests are the highest attained and reported in the literature. This paper summarizes the status of irradiation experience at the facility, presents some general conclusions, and reviews the potential for obtaining additional significant data.

23464 (WHC-SA–1682) **Transport of radioactive material in liquid sodium.** Brehm, W.F. Westinghouse Hanford Co., Richland, WA (United States). Mar 1993. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. (CONF-930376–1: International seminar on liquid metal systems: material behavior and physical chemistry in liquid metal systems II, Karlsruhe (Germany), 16-18 Mar 1993). Order Number DE93011355. Source: OSTI; NTIS; INIS; GPO Dep.

This paper describes the development of measurement and control techniques for radioactive materials in liquid sodium systems, as applied to the Fast Flux Test Facility (FFTF). The FFTF is a three-loop, sodium cooled fast reactor located on the US Department of Energy (USDOE) Hanford Site in Washington state. It achieved criticality in 1980, operated at its full rated power of 400 MWt until 1986, operated at 291MWt from 1986 until 1992, and is now (March 1993) in standby condition. Three primary loops transfer heat from the core to intermediate heat exchangers (IHX), which in turn transfer the heat to the secondary sodium system. The secondary system consists of three independent loops, each connected to an air-dump heat exchanger. Sodium purification is achieved by one cold trap on the primary system and one cold trap on each of the secondary loops. The cold traps are normally on line, but have been taken off line on occasion for repairs. A trap to remove radioactive cesium from primary sodium has been operated since 1987.

23465 (WSRC-TR–91-481) **User's manual for GILDA: An infinite lattice diffusion theory calculation.** Le, T.T. Westinghouse Savannah River Co., Aiken, SC (United States). Nov 1991. 38p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE93014754. Source: OSTI; NTIS; GPO Dep.

GILDA is a static two-dimensional diffusion theory code that performs either buckling (B^2) or k-effective (k_{eff}) calculations for an infinite hexagonal lattice which is constructed by repeating identical seven-cell zones (one cell is one or seven identical homogenized hexes). GILDA was written by J. W. Stewart in 1973. This user's manual is intended to provide all of the information necessary to set up and execute a GILDA calculation and to interpret the output results. It is assumed that the user is familiar with the computer (VAX/VMS or IBM/MVS) and the JOSHUA system database on which the code is implemented. Users who are not familiar with the JOSHUA database are advised to consult additional references to understand the structure of JOSHUA records and data sets before turning to section 4 of this manual. Sections 2 and 3 of this manual serve as a theory document in which the basic diffusion theory and the numerical approximations behind the code are described. Section 4 describes the functions of the program's subroutines. Section 5 describes the input data and tutors the user how to set up a problem. Section 6 describes the output results and the error messages which may be encountered during execution. Users who only wish to learn how to run the code without understanding the theory can start from section 4 and use sections 2 and 3 as references. Finally, the VAX/VMS and the IBM execution command files together with sample input records are provided in the appendices at the end of this manual.

23466 (WSRC-TR–93-085) **FLOWTRAN-TF user guide.** Flach, G.P.; Lee, S.Y.; Aleman, S.E. Westinghouse Savannah River Co., Aiken, SC (United States). Feb 1993. 79p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE93014743. Source: OSTI; NTIS; GPO Dep.

This document is a set of detailed instructions and guidelines to aid users in constructing and interpreting FLOWTRAN-TF input and output files for version 1.2 of the source code. The document assumes the user is familiar with the FLOWTRAN-TF Software Design report, SRS fuel assembly hardware, and two-phase flow. General code capabilities and input options are summarized. Then, detailed instructions for creating and interpreting code input files are given next. A sample input deck and corresponding output files are listed for reference and illustration. FLOWTRAN-TF is a two-phase thermal-hydraulics code of similar technology to existing commercial reactor codes such as RELAP and TRAC but customized for Savannah River Site applications. The code may be used to simulate solid components, fluid coolant flow and solid-fluid heat transfer, or fluid flow only (adiabatic flow channels). Pure component water or two-component air-water flows may be modeled. A variety of materials may be chosen for the solid tubes separating flow channels. FLOWTRAN-TF is fundamentally a transient analysis tool.

2106 Power Reactors, Mobile, Propulsion, Package, and Transportable

Refer also to citation(s) 23636, 23780

23467 (DOE/FTR–93010184) **[Space nuclear technology]: Foreign trip report, September 11–October 12, 1992.** Walker, J.V. Sandia National Labs., Albuquerque, NM (United States). 1 Dec 1992. 21p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. Order Number DE93010184. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Member of Industry-Lab-Government delegation invited to visit the Commonwealth of Independent States (CIS) to attend Nuclear Rocket Engines Conference in Semipalatinsk-21, Kazakhstan; visit a number of nuclear facilities; participate in technical discussions at several Russian organizations involved with space nuclear technology; discuss possibilities of Sandia participation in US/CIS programs. Significant programs exist in the CIS in these areas, but appear to have slowed due to funding difficulties and national priorities. The CIS possesses valuable technologies of significant relevance to current US interests and programs which they seem willing to make available to the US as relations between the US and the CIS improve.

23468 (EGG-M–92413) **A modular gas-cooled cermet reactor system for planetary base power.** Jahshan, S.N.; Borkowski, J.A. EG and G Idaho, Inc., Idaho Falls, ID (United States). 16 Oct 1992. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-76ID01570. (CONF-930103–33: 10. symposium on space nuclear power and propulsion, Albuquerque, NM (United States), 10-14 Jan 1993). Order Number DE93013672. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Fission nuclear power is foreseen as the source for electricity in planetary colonization and exploration. This report discusses a six module gas-cooled, cermet-fueled reactor which is proposed to meet the design objectives. The highly enriched core is compact

and can operate at high temperature for a long life. The helium coolant powers six modular Brayton cycles that compare favorably with the SP- 100-based Brayton cycle.

23469 (EGG-M–92502) **Nuclear propulsion systems engineering.** Madsen, W.W.; Neuman, J.E.: Van Haaften, D.H. EG and G Idaho, Inc., Idaho Falls, ID (United States). [1992]. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-76ID01570. (CONF-920803–17: Nuclear technologies for space exploration, Jackson, WY (United States), 16-19 Aug 1992). Order Number DE93010791. Source: OSTI; NTIS; INIS; GPO Dep.

The Nuclear Energy for Rocket Vehicle Application (NERVA) program of the 1960's and early 1970's was dramatically successful, with no major failures during the entire testing program. This success was due in large part to the successful development of a systems engineering process. Systems engineering, properly implemented, involves all aspects of the system design and operation, and leads to optimization of theentire system: cost, schedule, performance, safety, reliability, function, requirements, etc. The process must be incorporated from the very first and continued to project completion. This paper will discuss major aspects of the NERVA systems engineering effort, and consider the implications for current nuclear propulsion efforts.

23470 (EGG-NE–10391) **Gas core nuclear thermal rocket engine research and development in the former USSR.** Koehlinger, M.W.; Bennett, R.G.; Motloch, C.G. (eds.); Gurfink, M.M. EG and G Idaho, Inc., Idaho Falls, ID (United States). Sep 1992. 63p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-76ID01570. Order Number DE93012165. Source: OSTI; NTIS; INIS; GPO Dep.

Beginning in 1957 and continuing into the mid 1970s, the USSR conducted an extensive investigation into the use of both solid and gas core nuclear thermal rocket engines for space missions. During this time the scientific and engineering. problems associated with the development of a solid core engine were resolved. At the same time research was undertaken on a gas core engine, and some of the basic engineering problems associated with the concept were investigated. At the conclusion of the program, the basic principles of the solid core concept were established. However, a prototype solid core engine was not built because no established mission required such an engine. For the gas core concept, some of the basic physical processes involved were studied both theoretically and experimentally. However, no simple method of conducting proof-of-principle tests in a neutron flux was devised. This report focuses primarily on the development of the. gas core concept in the former USSR. A variety of gas core engine system parameters and designs are presented, along with a summary discussion of the basic physical principles and limitations involved in their design. The parallel development of the solid core concept is briefly described to provide an overall perspective of the magnitude of the nuclear thermal propulsion program and a technical comparison with the gas core concept.

23471 (WINCO–11917) **Opacities of uranium-hydrogen gas mixtures at high temperatures and pressures.** Tanner, J.E. (EG and G Idaho, Inc., Idaho Falls, ID (United States)). Westinghouse Idaho Nuclear Co., Inc., Idaho Falls, ID (United States). [1993]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-84ID12435. Order Number DE93014879. Source: OSTI; NTIS; INIS; GPO Dep.

Opacities of mixtures of hydrogen and uranium gases are needed for model calculations presently underway, on gas-core nuclear propulsion engines. Opacities over a range of temperatures, pressures, and wavelengths are available for uranium and hydrogen individually. Opacities for mixtures of hydrogen and uranium in various proportions, totaling 1.013×10^8 NM^{-2} (1000atm) are presented here.

23472 (WSRC-RP–92-910) **Summary of the SRS Severe Accident Analysis Program, 1987–1992.** Long, T.A.; Hyder, M.L.; Britt, T.E.; Allison, D.K.; Chow, S.; Graves, R.D.; DeWald, A.B. Jr.; Monson, P.R. Jr.; Wooten, L.A. Westinghouse Savannah River Co., Aiken, SC (United States). Nov 1992. 47p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE93013690. Source: OSTI; NTIS; INIS; GPO Dep.

The Severe Accident Analysis Program (SAAP) is a program of experimental and analytical studies aimed at characterizing severe accidents that might occur in the Savannah River Site Production Reactors. The goals of the Severe Accident Analysis Program are: To develop an understanding of severe accidents in SRS reactors that is adequate to support safety documentation for these reactors, including the Safety Analysis Report (SAR), the Probabilistic Risk Assessment (PRA), and other studies evaluating the safety of reactor operation; To provide tools and bases for the evaluation of existing or proposed safety related equipment in the SRS reactors; To provide bases for the development of accident management procedures for the SRS reactors; To develop and maintain on the site a sufficient body of knowledge, including documents, computer codes, and cognizant engineers and scientists, that can be used to authoritatively resolve questions or issues related to reactor accidents. The Severe Accident Analysis Program was instituted in 1987 and has already produced a substantial amount of information, and specialized calculational tools. Products of the Severe Accident Analysis Program (listed in Section 9 of this report) have been used in the development of the Safety Analysis Report (SAR) and the Probabilistic Risk Assessment (PRA), and in the development of technical specifications for the SRS reactors. A staff of about seven people is currently involved directly in the program and in providing input on severe accidents to other SRS activities.

2107 Regulation and Licensing

Refer also to citation(s) 23649

23473 (NUREG–0540-Vol.15-No.1) **Title list of documents made publicly available, January 1–31, 1993: Volume 15, No. 1.** Nuclear Regulatory Commission, Washington, DC (United States). Div. of Freedom of Information and Publications Services. Mar 1993. 336p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). Source: OSTI; NTIS; INIS; GPO.

This document is a monthly publication containing descriptions of information received and generated by the US Nuclear Regulatory Commission (NRC). This information includes (1) docketed material associated with civilian nuclear power plants and other uses of radioactive materials, and (2) nondocketed material received and generated by NRC pertinent to its role as a regulatory agency. The following indexes are included: Personal Author, Corporate Source, Report Number, and Cross Reference of Enclosures to Principal Documents.

23474 (NUREG–0540-Vol.15-No.2) **Title list of documents made publicly available, February 1–28, 1993: Volume 15, No. 2.** Nuclear Regulatory Commission, Washington, DC (United States). Div. of Freedom of Information and Publications Services. Apr 1993. 328p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). Source: OSTI; NTIS; INIS; GPO.

This document is a monthly publication containing descriptions of information received and generated by the US Nuclear Regulatory Commission (NRC). This information includes (1) docketed material associated with civilian nuclear power plants and other uses of radioactive materials, and (2) nondocketed material received and generated by NRC pertinent to its role as a regulatory agency. The following indexes are included: Personal Author, Corporate Source, Report Number, and Cross Reference of Enclosures to Principal Documents.

23475 (NUREG–0540-Vol.15-No.3) **Title list of documents made publicly available, March 1–31, 1993: Volume 15, No. 3.** Nuclear Regulatory Commission, Washington, DC (United States). Div. of Freedom of Information and Publications Services. May 1993. 422p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). Source: OSTI; NTIS; INIS; GPO.

The Title List of Documents Made Publicly Available is a monthly publication. It contains descriptions of the information received and generated by the US Nuclear Regulatory Commission (NRC). This information includes (1) docketed material associated with civilian nuclear power plants and other uses of radioactive materials and (2) nondocketed material received and generated by NRC pertinent to its role as a regulatory agency. As used here, docketed does not

refer to Court dockets; it refers to the system by which NRC maintains its regulatory records. This series of documents is indexed by a Personal Author Index, a Corporate Source Index, and a Report Number Index. The docketed information contained in the Title List includes the information formerly issued through the Department of Energy publication Power Reactor Docket Information, last published in January 1979. NRC documents that are publicly available may be examined without charge at the NRC Public Document Room (PDR). Duplicate copies may be obtained for a fee. Standing orders for certain categories of documents are also available. Clients may search for and order desired titles through the PDR computerized Bibliographic Retrieval System, which is accessible both at the PDR and remotely. The PDR is staffed by professional technical librarians, who provide reference assistance to users. See NOTES at the end of the preface for information about reaching the PDR. Microfiche of the docketed information listed in the Title List is available for sale on a subscription basis from the National Technical Information Service (NTIS). See NOTES at the end of the Preface for the complete NTIS address. We encourage your comments, criticisms, and suggestions. In particular, if there are title descriptions that are not meaningful, please let us know so that we can correct the data base. Insofar as possible, we would like this document to be a valuable part of your reference material.

23476 (NUREG–0750-Vol.36-Index1) **Indexes to Nuclear Regulatory Commission issuances, July–September 1992: Volume 36, Index 1.** Nuclear Regulatory Commission, Washington, DC (United States). Div. of Freedom of Information and Publications Services. Apr 1993. 47p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). Source: OSTI; NTIS; INIS; GPO.

Digests and indexes for issuances of the Commission (CLI), the Atomic Safety and Licensing Board Panel (LBP), the Administrative Law Judges (ALJ), the Directors' Decisions (DD), and the Denials of Petitions for Rulemaking (DPRM) are presented in this document. These digests and indexes are intended to serve as a guide to the issuances. These information elements are displayed in one or more of five separate formats arranged as follows: 1. Case Name Index: The case name index is an alphabetical arrangement of the case names of the issuances. Each case name is followed by the type of hearing, the type of issuance, docket number, issuance number, and full text reference. 2. Digests and Headers: The headers and digests are presented in issuance number order as follows: the Commission (CLI), the Atomic Safety and Licensing Board Panel (LBP), the Administrative Law Judge (ALJ), the Directors' Decisions (DD), and the Denials of Petitions for Rulemaking (DPRM). The header identifies the issuance by issuance number, case name, facility name, docket number, type of hearing, date of issuance, and type of issuance. 3. Legal Citations Index: This index is divided into four parts and consists of alphabetical or alpha-numerical arrangements of Cases, Regulations, Statutes, and Others. These citations are listed as given in the issuances. Changes in regulations and statutes may have occurred to cause changes in the number or name and/or applicability of the citation. It is therefore important to consider the date of the issuance. 4. Subject Index: Subject words and/or phrases, arranged alphabetically, indicate the issues and subjects covered in the issuances. 5. Facility Index: The index consists of an alphabetical arrangement of facility names from the issuance. The name is followed by docket number, type of hearing, data, type of issuance, issuance number, and full text reference.

23477 (NUREG–0750-Vol.36-No.6) **Nuclear Regulatory Commission issuances, December 1992: Volume 36, No. 6.** Nuclear Regulatory Commission, Washington, DC (United States). Div. of Freedom of Information and Publications Services. [1992]. 49p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). Source: OSTI; NTIS; INIS; GPO.

This report includes the issuances received during the specified period from the Commission (CLI), the Atomic Safety and Licensing Boards (LBP), the Administrative Law Judges (ALJ), the Directors' Decisions (DD), and the Denials of Petitions for Rulemaking (DPRM).

23478 (NUREG–0936-Vol.12-No.1) **NRC regulatory agenda: Quarterly report, January–March 1993: Volume 12, No. 1.** Nuclear Regulatory Commission, Washington, DC (United States). Div. of Freedom of Information and Publications Services. Apr 1993. 118p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). Source: OSTI; NTIS; INIS; GPO.

The NRC Regulatory Agenda is a compilation of all rules on which the NRC has recently completed action, or has proposed action, or is considering action, and all petitions for rulemaking which have been received by the Commission and are pending disposition by the Commission. The Regulatory Agenda is updated and issued each quarter.

23479 (NUREG–0940-Vol.11-No.4) **Enforcement actions: Significant actions resolved: Quarterly progress report, October–December 1992: Volume 11, No. 4.** Nuclear Regulatory Commission, Washington, DC (United States). Office of Enforcement. Mar 1993. 317p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). Source: OSTI; NTIS; INIS; GPO.

This compilation summarizes significant enforcement actions that have been resolved during one quarterly period (October–December 1992) and includes copies of letters, Notices, and Orders sent by the Nuclear Regulatory Commission to licensees with respect to these enforcement actions. It is anticipated that the information in this publication will be widely disseminated to managers and employees engaged in activities licensed by the NRC, so that actions can be taken to improve safety by avoiding future violations similar to those described in this publication.

2108 Economics

Refer also to citation(s) 22881, 23456, 23457, 23568, 23582, 23589, 23668

23480 (FEI–2183) **Nuclear fuel cycle based on thorium and uranium-233.** Kazantsev, G.N.; Murogov, V.M.; Raskach, F.P.; Rudneva, V.Ya.; Smetanin, Eh.Ya.; Troyanov, M.F.; Chernov, L.A.; Aborina, I.N. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk (Russian Federation). Fiziko-Ehnergeticheskij Inst. 1991. [48p.] (In Russian). Order Number DE93626232. Source: OSTI; NTIS (US Sales Only); INIS.

The analysis of activities carried out in this country and abroad on a complex solution of principal problems of nuclear power advance. Demonstration of the potentiality of the above problems solution on the basis of conventional reactor plant development (light water cooled reactors and BN-type fast reactors) within the framework of nuclear fuel cycle using uranium-235, plutonium and uranium-233. 28 refs.; 1 fig.; 8 tabs.

22 NUCLEAR REACTOR TECHNOLOGY

Refer also to citation(s) 23748, 25120

2201 Theory and Calculation

Refer also to citation(s) 23372, 23571, 24184, 25156, 25397, 25400, 25401, 25407

23481 (CEA-CONF–11276) **An anisotropic scattering treatment for the even parity transport equation.** Akherraz, B.; Fedon-Magnaud, C.; Lautard, J.J. CEA Centre d'Etudes de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Mecanique et de Technologie. 1993. [9p.] (CONF-930404–: International topical meeting on mathematical methods and supercomputing in nuclear applications (M&C+SNA '93), Karlsruhe (Germany), 19-23 Apr 1993). Order Number DE93626210. Source: OSTI; NTIS (US Sales Only); INIS.

This work introduces an extension of the even-odd parity flux formulation to the treatment of anisotropic scattering with the finite element formulation. To keep a similar form to the even parity transport equation in the isotropic case, we define a 'direction-dependent cross section'. We have only two unknown functions (the even parity flux, and the direction dependent cross section),

that are calculated via an iterative process. We consider the multigroup equation for the eigenvalue problem and we present some numerical tests to prove the effectiveness of this method.

23482 (CEA-CONF–11277) **Importance function by collision probabilities for Monte Carlo code Tripoli.** Morillon, B.; Both, J.P.; Nimal, J.C. CEA Centre d'Etudes de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Mecanique et de Technologie. 1993. [11p.] (CONF-930404–: International topical meeting on mathematical methods and supercomputing in nuclear applications (M&C+SNA '93), Karlsruhe (Germany), 19-23 Apr 1993). Order Number DE93626211. Source: OSTI; NTIS (US Sales Only); INIS.

We present a completely automatic biasing technique where the parameters of the biased simulation are deduced from the solution of the adjoint transport equation calculated by collision probabilities. In this study we shall estimate the importance function through collision probabilities method and we shall evaluate its possibilities thanks to a Monte Carlo calculation. We have run simulations with this new biasing method for one-group transport problems with isotropic shocks (one dimension geometry and X-Y geometry) and for multigroup problems with anisotropic shocks (one dimension geometry). For the anisotropic problems we solve the adjoint equation with anisotropic collision probabilities. The results show that for the one-group and homogeneous geometry transport problems the method is quite optimal without Splitting and Russian Roulette technique but for the multigroup and heterogeneous X-Y geometry ones the figures of merit are higher if we add Splitting and Russian Roulette technique.

23483 (FEI–2184) **Effect of the reactor heterogeneous structure on K_∞ value determined by the reactivity method.** Dulin, V.A.; Mikhajlov, G.M. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk (Russian Federation). Fiziko-Ehnergeticheskij Inst. 1991. [13p.] (In Russian). Order Number DE93626212. Source: OSTI; NTIS (US Sales Only); INIS.

The paper deals with the calculation of the multiplication medium heterogeneous structure influence on K^+ value (closed to the K_∞ value) derived from cell reactivity measurement. It is shown that heterogeneous structure requires for making the spectral calculations differing from traditional ones. Comparative analysis of heterogeneity corrections in K^+ value on the basis of the calculations by different codes have been performed. The calculation results are compared with experimental ones. 7 refs.; 3 tabs.

23484 (JAERI-M–93-040) **Design of H_∞ optimal estimator for linear time-invariant system: State space design approach and its application to reactivity estimation.** Suzuki, Katsuo (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Tokai Research Establishment); Shimazaki, Junya; Shinohara, Yoshikuni. Japan Atomic Energy Research Inst., Tokyo (Japan). Mar 1993. 31p. (In Japanese). Order Number DE93797603. Source: OSTI; NTIS; INIS.

H_∞ optimal estimation theory is formulated as a minimax problem where the maximum 'energy' of estimation error over all disturbance trajectories in L_2 functional space is minimized in the sense of H_∞-norm. A design method based on the characteristics of the formulation is presented in which design specifications can be taken into account as frequency weights for the objective function. We applied this method to design a reactivity estimator for a fast breeder reactor. In the design was used a system model which consists of usual reactor point kinetics equations combined with a state equation of net reactivity driven by fictitious noise/disturbance. Finally, we show by computer simulation that H_∞ estimator gives good results in estimating net reactivity changes caused by various disturbances. (author).

23485 (KFKI–1992-18/G) **On the eigenfrequencies of fuel rod vibration in NPPs.** Lipcsei, S. (Atomic Energy Research Inst., Budapest (Hungary). Dept. of Applied Reactor Physics); Kiss, S.; Por, G. Hungarian Academy of Sciences, Budapest (Hungary). Central Research Inst. for Physics. May 1992. [19p.] Order Number DE93626213. Source: OSTI; NTIS (US Sales Only); INIS.

In neutron fluctuation spectra measured in nuclear reactors, in-core vibrations appear generally as separate frequency peaks. Therefore, neutron fluctuation spectra can be used to analyze these vibrations and to obtain information for diagnostic purposes. Eigenfrequencies of fuel pins were calculated using fourth-order differential equation for vibration. Theoretical results were verified experimentally. It was shown that the series of eigenfrequencies follow a quadratic trend, and in the dependence of eigenfrequencies on constraints the low-order modes are largely influenced. Experimental and calculated results agree fairly well. (R.P.) 13 refs.; 10 figs.; 3 tabs.

23486 (LIYaF–1612) **Account for temperature distribution heterogenelty in research reactor kinetics calculations: KINO program.** Dik, G.R.; Shustov, V.A. AN SSSR, Leningrad (Russian Federation). Inst. Yadernoj Fiziki. Jun 1990. [30p.] (In Russian). Order Number DE93626214. Source: OSTI; NTIS (US Sales Only); INIS.

A calculation model for a research reactor kinetics with reactivity feedback is investigated. The neutron kinetics equation (reactor power and delayed neutron precursor) are taken in one point approximation. The heat kinetics equation for time dependent full and water temperature distribution are solved for each subregion (node), into which the core is divided. Using the first order perturbation theory the statistical weghts of separate nodes are determined. The model of the research reactor kinetics considered is realized in the KINO (KInetic NOdes) program. 14 refs.; 9 figs.; 1 tab.

23487 (NUREG/IA–0094) **Assessment of RELAP5/MOD3 against twenty-five post-dryout experiments performed at the Royal Institute of Technology.** Nilsson, L. (Swedish Nuclear Power Inspectorate, Stockholm (Sweden)). Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Regulatory Research; Swedish Nuclear Power Inspectorate, Stockholm (Sweden). May 1993. 89p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). (STUDSVIK/NS–90/93). Source: OSTI; NTIS; INIS; GPO.

Assessment of RELAP5/MOD2 has been made against various experimental data, among others data from twenty-five post-dryout experiments conducted at the Royal Institute of Technology (RIT) in Stockholm. As the MOD3 version of RELAP5 has now been released, incorporating a different method of calculating critical heat flux compared to RELAP5/MOD2, it seemed justified to make another assessment against the same RIT-data. The results show that the axial dryout position is generally better predicted by the MOD3 than by the MOD2 version. The prediction is, however, still nonconservative, i.e. the calculated dryout position falls in most cases downstream the actual measured point. While the pre-dryout heat transfer seems to be equal for MOD2 and MOD3, both versions giving slightly higher wall temperatures than the experiments, there is a considerable difference in the post-dryout heat transfer. The results of the RIT data comparison indicate that MOD3 underpredicts the post-dryout wall temperatures remarkably while MOD2 gave reasonable agreement. In this respect RELAP5/MOD3 shows no improvement over RELAP5/MOD2.

23488 (WINCO–1110) **Validation of MCNP, a comparison with SCALE: Part 2, Highly enriched uranium metal systems.** Crawford, C.; Palmer, B.M. Westinghouse Idaho Nuclear Co., Inc., Idaho Falls, ID (United States). Oct 1992. 39p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-84ID12435. Order Number DE93012545. Source: OSTI; NTIS; INIS; GPO Dep.

This is Part 2 of a series of validation studies dealing with highly enriched uranium systems. For this study six sets of critical experiments involving uranium metal have been modeled and an effective multiplication factor, k_{eff}, calculated for each experiment. An earlier study[1] addresses the validation of MCNP for use with highly enriched uranium solutions. The calculations of k_{eff} were performed using MCNP 4. MCNP is a Monte Carlo based transport code which used continuous energy nuclear data for these calculations. END/B-V cross sections were used for this study- This report also compares the results of MCNP with the results of the CSAS25 module of SCALE 4 using the 27 group END/B-IV cross sections. Provided in Section 2 are general descriptions of the experiments performed. Section 3, Results, consists primarily of tables listing the calculated K_{eff}'s. Lastly, Sections 4 and 5 give a general discussion of observed trends in the results and suggested biases.

23489 (WINCO–1117) **Validation of the CSAS25 module of SCALE: Part 2, Highly enriched uranium metal systems.** Palmer, B.M.; Crawford, C. Westinghouse Idaho Nuclear Co., Inc., Idaho Falls, ID (United States). Sep 1991. 37p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-84ID12435. Order Number DE93012543. Source: OSTI; NTIS; INIS; GPO Dep.

This is Part 2 of a series of validation studies dealing with highly enriched uranium systems. For this study six sets of critical experiments involving uranium metal have been modeled and an effective multiplication factor, k_{eff}, calculated for each experiment. The calculations of k_{eff} were performed using the CSAS25 module of SCALE 4. The CSAS25 module is made up of three distinct programs, BONAMI-II, NITAWL-II, and KENO Va. BONAMI-II and NITAWL-II are cross section manipulation routines capable of adjusting cross sections to take into account effects due to temperature, geometry, and composition. KENO Va is a monte carlo program that determines k_{eff} using the adjusted cross sections. Three cross section libraries available in SCALE were used for this study, the 16 group Hansen-Roach, the 27 group END/B-IV, and the 123 group Gam-Thermos. Provided in Section 2 are general descriptions of the experiments performed. Section 3, Results, consists primarily of tables listing the calculated k_{eff}'s. Lastly, Sections 4 and 5 give a general discussion of observed trends in the results and suggested biases.

23490 (WINCO–1118) **Validation of the CSAS25 module of SCALE: Part 3, Highly enriched uranium oxide systems.** Palmer, B.M.; Crawford, C. Westinghouse Idaho Nuclear Co., Inc., Idaho Falls, ID (United States). Oct 1991. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-84ID12435. Order Number DE93014823. Source: OSTI; NTIS; INIS; GPO Dep.

This is Part 3 of a series of validation studies dealing with highly enriched uranium systems. For this study only one set of critical experiments involving uranium dioxide have been modeled. The calculations of k_{eff} were performed using the CSAS25 module of SCALE 4. The CSAS25 module is made up of three distinct programs, BONAMI-II, NITAWL-II, and KENO V.a. BONAMI-II and NITAWL-II are cross section manipulation routines capable of adjusting cross sections to take into account effects due to temperature, geometry, and composition. KENO V.a is a monte carlo program that determines k_{eff} using the adjusted cross sections. Three cross section libraries available in SCALE were used for this study, the 16 group Hansen-Roach, the 27 group ENDF/B-IV, and the 123 group Gam-Thermos. Part 1 includes descriptions of the cross sections and the cross section manipulation routines. What follows in Section 2 are general descriptions of the experiments performed. Section 3, Results, consists primarily of tables listing the calculated k_{eff}'s. Lastly, Sections 4 and 5 give a general discussion of observed trends in the results and suggested biases.

2202 Components and Accessories

Refer also to citation(s) 23326, 23536, 23549, 23562, 23569, 23590, 23615, 23646, 23650, 23660, 23662, 23663, 23667, 23674, 23686

23491 (CONF-930803–4) **Continuing the service of aging concrete structures in nuclear power plants.** Naus, D.J. (Oak Ridge National Lab., TN (United States)); Oland, C.B.; Arndt, E.G. Oak Ridge National Lab., TN (United States). [1993]. 6p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC05-84OR21400. From 12. biennial conference for the International Association for Structural Mechanics in Reactor Technology; Stuttgart (Germany); 16-20 Aug 1993. Order Number DE93009713. Source: OSTI; NTIS; INIS; GPO Dep.

The (SAG) Structural Aging Program has the objective of preparing documentation to help provide criteria for use by the USNRC in evaluating requests for continuing the service of NPPs. The program consists of three tasks: Materials property data base, structural component assessment/repair technologies, and quantitative methodology for continued service determinations. These tasks are detailed in this report.

23492 (CONF-930803–5) **A data base for aging of structural materials.** Oland, C.B. (Oak Ridge National Lab., TN (United States)); Naus, D.J.; Jerath, S. Oak Ridge National Lab., TN (United States). [1993]. 6p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC05-84OR21400. From 12. biennial conference for the International Association for Structural Mechanics in Reactor Technology; Stuttgart (Germany); 16-20 Aug 1993. Order Number DE93009714. Source: OSTI; NTIS; INIS; GPO Dep.

USNRC initiated a Structural Aging (SAG) Program ORNL. The objective of the program is to provide assistance in identifying potential structural safety issues and to establish acceptance criteria for use in nuclear power plant evaluations for continued service. One main part focuses on the development of a Structural Materials Information Center where long-term and environment-dependent material properties are being collected and assembled into a data base. This data base is presented in two complementary formats. The Structural Materials Handbook is an expandable, hard-copy reference document that contains the complete data base for each material. The Structural Materials Electronic Data Base is accessible using an IBM-compatible personal computer. This paper presents an overview of the Structural Materials Information Center and briefly describes the features of the handbook and the electronic data base. In addition, a proposed method for using the data base to establish current property values for materials in existing concrete structures and to estimate the future performance of these materials is also presented.

23493 (DPW–53-3-6) **Construction concerns for Savannah River's Explosives Department,Building 773A and Building 232.** List, J.A. Du Pont de Nemours (E.I.) and Co., Wilmington, DE (United States). 27 Mar 1953. 2p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. (SR/H–516). Order Number DE93012044. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Short communication. BUILDINGS/design; FOILS/procurement; BUILDINGS; DESIGN; FOILS; PROCUREMENT; SAVANNAH RIVER PLANT; ALUMINIUM; CONSTRUCTION; ENGINEERING

23494 (EGG-M–92476) **The effects of load-sensitive behavior on the operability margins of motor-operated gate valves.** Steele, R. Jr.; Russell, M.J.; DeWall, K.G.; Watkins, J.C. EG and G Idaho, Inc., Idaho Falls, ID (United States). [1993]. 11p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC07-76ID01570. (CONF-930803–11: 12. biennial conference for the International Association for Structural Mechanics in Reactor Technology, Stuttgart (Germany), 16-20 Aug 1993). Order Number DE93013680. Source: OSTI; NTIS; INIS; GPO Dep.

Testing of motor-operated gate valves at various loads has produced a phenomenon we call load-sensitive behavior. This phenomenon has a significant effect on the accuracy of the methods used (and proposed) in the nuclear industry for determining that these valves can perform their design basis function. A valve subjected to tests with low flow and pressure loadings may achieve a stem thrust (at seating) analytically determined to be adequate for design basis flows and pressures, but this is no guarantee that the valve will achieve the same stem thrust when actually subjected to those design basis loads. This is because the friction at the interface between the stem and the stem nut is higher in tests with higher flow and pressure loadings, and this loss to friction is outside the control of the motor-operator's torque switch. This paper identifies a tentative method for determining, a stable, useful value for the stem/stem-nut coefficient of friction, one that can possibly be extrapolated and used in calculations to accurately estimate the design basis thrust requirements of these valves.

23495 (FEI–2166) **Two-fluid model for calculating the two-phase flow in reactor fuel assemblies: Equations, system of closure coefficients.** Bogoslovskaya, G.P.; Bogatyrev, I.L.; Zhukov, A.V.; Sorokin, A.P.; Titov, P.A. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk (Russian Federation). Fiziko-Ehnergeticheskij Inst. 1991. [38p.] (In Russian). Order Number DE93626215. Source: OSTI; NTIS (US Sales Only); INIS.

The full formation of two-fluid model of two-phase flow in reactor fuel subassembly, including 6 equations of mass, momentum and energy conservation, 3 interface equations and closure relations for different coolants in a wide range of the Prandtl numbers (water, liquid metal) is presented. As a result of analysis performed the correlations for interphase exchange by mass, momentum and heat, interphase area, slip ratio, friction and heat transfer are recomended. 26 refs.; 3 figs.; 6 tabs.

23496 (INIS-mf–13503, pp. 64-67) **Advanced repair methods for enhanced reactor safety.** Kornfeldt, H. (ABB Atom AB, Vaesteraas (Sweden)). European Nuclear Society (ENS), Bern (Switzerland); Czech Nuclear Society, Prague (Czech Republic); Slovak Nuclear Society, Bratislava (Slovakia). Jan 1993. (CONF-921068–: East-West topical meeting: the safe and reliable operation of light water reactor NPP's, Prague (Czechoslovakia), 18-21 Oct 1992). In *Topform '92: the safe and reliable operation of LWR NPPs. Vol. II: Poster papers.* [245p.] Order Number DE93625345. Source: OSTI; NTIS (US Sales Only); INIS.

A few innovative concepts are described of the ABB Atom Service Division for repair and mitigation techniques for primary systems in nuclear power plants. The concepts are based on Shape Memory Alloy (SMA) technology. A basic feature of all methods is that welding and component replacement is being avoided and the radiation dose imposed on maintenance personnel reduced. The SMA-based repair methods give plant operators new ways to meet increased safety standards and rising maintenance costs. (Z.S.) 4 figs.

23497 (INIS-mf–13503, pp. 72-75) **An enhanced preventive maintenance concept for NPP's.** Morley, M. (Colenco Power Consulting Ltd., Baden (Switzerland)); Ronecker, W. European Nuclear Society (ENS), Bern (Switzerland); Czech Nuclear Society, Prague (Czech Republic); Slovak Nuclear Society, Bratislava (Slovakia). Jan 1993. (CONF-921068–: East-West topical meeting: the safe and reliable operation of light water reactor NPP's, Prague (Czechoslovakia), 18-21 Oct 1992). In *Topform '92: the safe and reliable operation of LWR NPPs. Vol. II: Poster papers.* [245p.] Order Number DE93625345. Source: OSTI; NTIS (US Sales Only); INIS.

A method is described for the maintenance of equipment and components of a nuclear power plant. As a further development of currently applied maintenance strategies and plant specific requirements, a concept has been developed which enables classification into a logical and traceable arrangement. This classification system is based on the system design, construction characteristics and availability aspects. Systematically analyzing components from these aspects enables the preventive maintenance approach to be enhanced by the influence of the condition-based maintenance method. Using the results of operation data, an optimized maintenance programme can be developed that provides for safe operation, high availability and minimized maintenance costs. (Z.S.) 2 figs.

23498 (INIS-mf–13503, pp. 76-79) **Inspection, maintenance and component replacement: A systematic and safety related approach.** Paterson, A. (Scottish Nuclear Limited, East Kilbride (United Kingdom)). European Nuclear Society (ENS), Bern (Switzerland); Czech Nuclear Society, Prague (Czech Republic); Slovak Nuclear Society, Bratislava (Slovakia). Jan 1993. (CONF-921068–: East-West topical meeting: the safe and reliable operation of light water reactor NPP's, Prague (Czechoslovakia), 18-21 Oct 1992). In *Topform '92: the safe and reliable operation of LWR NPPs. Vol. II: Poster papers.* [245p.] Order Number DE93625345. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. NUCLEAR POWER PLANTS/inspection; REACTOR MAINTENANCE; INSPECTION; OCCUPATIONAL SAFETY; RELIABILITY

23499 (INIS-mf–13503, pp. 80-84) **Computerized management of plant intervention tasks.** Remacle, J. (Belgatom SA, Brussels (Belgium)); Quoidbach, G. European Nuclear Society (ENS), Bern (Switzerland); Czech Nuclear Society, Prague (Czech Republic); Slovak Nuclear Society, Bratislava (Slovakia). Jan 1993. (CONF-921068–: East-West topical meeting: the safe and reliable operation of light water reactor NPP's, Prague (Czechoslovakia), 18-21 Oct 1992). In *Topform '92: the safe and reliable operation of LWR NPPs. Vol. II: Poster papers.* [245p.] Order Number DE93625345. Source: OSTI; NTIS (US Sales Only); INIS.

The concept of 'computerized management' of plant intervention tasks was developed by TRACTEBEL in 1983 for the Belgian power plants of ELECTRABEL. The main objective of the 'Computerized Management of Plant Intervention Tasks' is to help the staff of a nuclear or a conventional power plant in planning, organizing, and carrying out any (preventive or corrective) maintenance task. It consists of a group of interconnected functional modules acting on a unique and homogeneous data base. A short description of 3 modules is given, i.e., the 'User' Module, the 'Equipment' Module and the 'Periodic Procedure' Module. (Z.S.).

23500 (INIS-mf–13503, pp. 123-126) **Safety of existing installations under dynamic loads: observations on nonlinear response of piping systems - experiments, numerical analyses.** Habip, L.M. (Siemens AG Unternehmensbereich KWU, Offenbach am Main (Germany)); Jedlicka, J.; Kerkhof, K.; Schrammel, D. European Nuclear Society (ENS), Bern (Switzerland); Czech Nuclear Society, Prague (Czech Republic); Slovak Nuclear Society, Bratislava (Slovakia). Jan 1993. (CONF-921068–: East-West topical meeting: the safe and reliable operation of light water reactor NPP's, Prague (Czechoslovakia), 18-21 Oct 1992). In *Topform '92: the safe and reliable operation of LWR NPPs. Vol. II: Poster papers.* [245p.] Order Number DE93625345. Source: OSTI; NTIS (US Sales Only); INIS.

The nonlinear response of piping systems under base excitation or due to pressure waves caused by simulated breaks and valve closure has been investigated experimentally at the HDR reactor. Structural analysis of ruptured piping and the related design of pipe whips restraints are usually performed on the basis of nonlinear material behavior, with powerful computational techniques being used increasingly. Some aspects of these developments (high-level earthquake tests, high-level pressure wave tests, pipe rupture nonlinear analyses) are summarized with implications for qualification and optimal backfitting of operating nuclear power plants. (Z.S.) 7 refs.

23501 (INIS-mf–13503, pp. 127-131) **Nuclear valves latest development.** Isaac, F. (Westinghouse Electric Corporation, Brussels (Belgium)); Monier, M. European Nuclear Society (ENS), Bern (Switzerland); Czech Nuclear Society, Prague (Czech Republic); Slovak Nuclear Society, Bratislava (Slovakia). Jan 1993. (CONF-921068–: East-West topical meeting: the safe and reliable operation of light water reactor NPP's, Prague (Czechoslovakia), 18-21 Oct 1992). In *Topform '92: the safe and reliable operation of LWR NPPs. Vol. II: Poster papers.* [245p.] Order Number DE93625345. Source: OSTI; NTIS (US Sales Only); INIS.

In the frame of Nuclear Power Plant upgrade (Emergency Power Supply and Emergency Core Cooling), Westinghouse had to face a new valve design philosophy specially for motor operated valves. The valves have to been designed to resist any operating conditions, postulated accident or loss of control. The requirements for motor operated valves are listed and the selected model and related upgrading explained. As part of plant upgrade and valves replacement, Westinghouse has sponsored alternative hardfacing research programme. Two types of materials have been investigated: nickel base alloys and iron base alloys. Programme requirements and test results are given. A new globe valve model (On-Off or regulating) is described developed by Alsthom Velan permitting the seat replacement in less than 10 min. (Z.S.) 2 figs.

23502 (INIS-mf–13503, pp. 207-210) **Valve monitoring ITI-MOVATS.** Moureau, S. (Westinghouse Energy Systems Inc., Brussels (Belgium)). European Nuclear Society (ENS), Bern (Switzerland); Czech Nuclear Society, Prague (Czech Republic); Slovak Nuclear Society, Bratislava (Slovakia). Jan 1993. (CONF-921068–: East-West topical meeting: the safe and reliable operation of light water reactor NPP's, Prague (Czechoslovakia), 18-21 Oct 1992). In *Topform '92: the safe and reliable operation of LWR NPPs. Vol. II: Poster papers.* [245p.] Order Number DE93625345. Source: OSTI; NTIS (US Sales Only); INIS.

ITI-MOVATS provides a wide range of test devices to monitor the performance of valves: motor operated gate or globe valve, butterfly valve, air operated valve, and check valve. The ITI-MOVATS

testing equipment is used in the following three areas: actuator setup/baseline testing, periodic/post-maintenance testing, and differential pressure testing. The parameters typically measured with the MOVATS diagnostic system as well as the devices used to measure them are described. (Z.S.).

23503 (NUREG/CR–5957) **System 80+™ containment: Structural design review.** Greimann, L. (Ames Lab., IA (United States)); Fanous, F.; Challa, R.; Bluhm, D. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Engineering; Ames Lab., IA (United States). May 1993. 110p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract W-7405-ENG-82. (IS–5083). Source: OSTI; NTIS; INIS; GPO.

A review of the structural design of the Combustion Engineering (CE) System 80+™ steel containment was completed. The stress analysis and the evaluation of the structure against buckling were performed by using BOSOR4 and BOSOR5 finite difference software, respectively. The CE System 80+™ containment was modelled as an axisymmetric shell consisting of different segments and mesh points with the additional mass of the penetrations and appurtenance being smeared around the circumference. The transition region was modelled using elastic springs with a foundation modulus of 180 lbs/in^3. The stresses due to the individual loads (dead loads, internal and external pressures and temperatures) were computed using the stress analysis option in the BOSOR4 program. The stresses from individual loads were combined according to ASME Code into stress intensities. Service Level B loadings produced a 20 percent over-stress in a small zone just above the transition region. All other stress intensities were within allowable limits. For the System 80+™, the perfect shell with an elastic material was initially analyzed. The calculated factor of safety values were 2.3 (Level B) and 1.59 (Levels C and D). Finally, sensitivity studies were conducted to investigate the effects of mesh size and transition zone stiffness on the controlling buckling load.

23504 (NUREG/CR–5972) **Effects of nonstandard heat treatment temperatures on tensile and Charpy impact properties of carbon-steel casting repair welds.** Nanstad, R.K. (Oak Ridge National Lab., TN (United States)); Goodwin, G.M.; Swindeman, M.J. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Engineering; Oak Ridge National Lab., TN (United States). Apr 1993. 107p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC05-84OR21400. (ORNL/TM–12280). Source: OSTI; NTIS; INIS; GPO.

This report discusses carbon steel castings which are used for a number of different components in nuclear power plants, including valve bodies and bonnets. Components are often repaired by welding processes, and both welded components and the repair welds are subjected to a variety of postweld heat treatments (PWHT) with temperatures as high as 899°C (1650°F), well above the normal 593 to 677°C (1100 to 1250°F) temperature range. The temperatures noted are above the A1 transformation temperature for the materials used for these components. A test program was conducted to investigate the potential effects of such "nonstandard" PWHTs on mechanical properties of carbon steel casting welds. Four weldments were fabricated, two each with the shielded-metal-arc (SMA) and flux-cored-arc (FCA) processes,with a high-carbon and low-carbon filler metal in each case. All four welds were sectioned and given simulated PWHTs at temperatures from 621 to 899°C (1150 to 1650°F) in increments of 56°C (100°F) and for times of 5, 10, 20, and 40 h at each temperature. Hardness, tensile, and Charpy V-notch (CVN) impact tests were conducted for the as-welded and heat-treated conditions.

23505 (ORNL/FTR–4398) **Heavy-section steel technology program: Foreign trip report, July 4–October 1, 1992.** McCabe, D.E. Oak Ridge National Lab., TN (United States). 16 Oct 1992. 17p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93009222. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The objective of this travel was to spend a 3-month work period at GKSS-Forschungzentrum in Geesthact, Germany, to work on the development of an American Society for Testing and Materials (ASTM) standard practice for transition range testing of pressure vessel steels. A side trip was made to the Technical Research Centre of Finland (VTT) to meet with Dr. K. Wallin. As a result of this work experience, a GKSS report has been produced that covers background research performed, and a proposed test standard has been prepared. This standard will be made available to the Nuclear Regulatory Commission (NRC) in the form of a NUREG report.

23506 (SAND–92-1977) **Analysis guidelines for Deterministic Severe Accident Criteria compliance.** Griffith, R.O.; Williams, D.C.; Gido, R.G. Sandia National Labs., Albuquerque, NM (United States). Mar 1993. 175p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. Order Number DE93013710. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The Deterministic Severe Accident Criteria (DSACs) were developed to help establish New Production Reactor containment design criteria that are based on the physical challenges that could potentially arise from a Severe Accident. The DSACs are composed of two parts: idealized problem statements that represent the physical challenges to the containment and success criteria for evaluating the containment's ability to accommodate these challenges. The values used to specify the physical challenges embody the uncertainty associated with Severe Accident phenomena, and the problem statements are structured to facilitate the designer's ability to demonstrate compliance with the design criteria. The development and establishment of the DSACs has been previously described. This document provides recommendations to the Department of Energy (DOE) regarding guidance that will enable designers to demonstrate compliance with the proposal DSACs. These guidelines are intended to provide guidance to the designer on acceptable design analyses so that the DOE will have a technically justifiable basis for their reviews of DSAC compliance well in advance of the actual design compliance process. This document emphasizes approaches to the calculation of Severe Accident loads and the resulting containment response. The analysis guidelines characterize an envelope of acceptable approaches and give specific criteria by which analysis methods not specifically described can be judged. A significant level of familiarity with Severe Accident phenomena was essential in the development of the analysis guidelines, primarily because, in some cases, the requirements of the highly complex phenomena were not obvious. However, it is important that the analysis guidelines be set by someone other than the designer, to avoid any appearance of conflict of interest.

23507 (SAND–92-2074C) **Analyses of separate effects tests for liner tearing in the 1:6 scale model of a reinforced concrete containment building.** Bergmann, V.L.; Weatherby, J.R.; Parks, M.B. Sandia National Labs., Albuquerque, NM (United States). [1993]. 7p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-930803–9: 12. biennial conference for the International Association for Structural Mechanics in Reactor Technology, Stuttgart (Germany), 16-20 Aug 1993). Order Number DE93009853. Source: OSTI; NTIS; INIS; GPO Dep.

In 1987, a 1:6 scale model of a reinforced concrete containment (RCA) building was tested at Sandia National Laboratories under the sponsorship of the US Nuclear Regulatory Commission (Herschel, 1988). Overpressurization of the scale model resulted in failure by liner tearing near an insert plate. The liner tear is believed to be a result of shear transfer from the concrete reinforcement to the liner through the studs (Weatherby, 1990). Separate effects tests were developed to further understand the mechanisms that led to the liner tearing in the 1:6 scale model. This paper describes finite element analyses used to predict the response and failure modes of the separate effects tests and presents comparisons of the finite element and experimental results.

23508 (UCRL-JC–110582) **Development and evaluation of a HEPA filter for increased strength and resistance to elevated temperature.** Gilbert, H. (Gilbert (Humphrey), McLean, VA (United States)); Bergman, W.; Fretthold, J.K. Lawrence Livermore National Lab., CA (United States). [1992]. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-920823–9: 22. Department of Energy (DOE)/Nuclear Regulatory Commission (NRC) nuclear air cleaning and treatment conference, Denver, CO (United States), 24-27 Aug 1992). Order Number DE93009545. Source: OSTI; NTIS; INIS; GPO Dep.

We have developed an improved HEPA filter for increased strength and resistance to elevated temperature to improve the reliability of HEPA filters under accident conditions. The improvements to the HEPA filter consist of a silicone rubber sealant and a new HEPA medium reinforced with a glass cloth. Several prototype filters were built and evaluated for temperature and pressure resistance and resistance to rough handling. The temperature resistance test consisted of exposing the HEPA filter to 1,000 scan at 700 degrees F for five minutes. The pressure resistance test consisted of exposing the HEPA filter to a differential pressure of 10 in. w.g. using a water saturated air flow at 95 degrees F. For the rough handling test, we used a vibrating machine designated the Q110. DOP filter efficiency tests were performed before and after each of the environmental tests. In addition to following the standard practice of using a separate new filter for each environmental test, we also subjected the same filter to the elevated temperature test followed by the pressure resistance test. The efficiency test results show that the improved HEPA filter is significantly better than the standard HEPA filter.

23509 (WSRC-MS–92-369) **Evaluation of stresses in large diameter, thin walled piping at support locations.** Bryan, B.J.; Flanders, H.E. Jr.; Rawls, G.B. Jr. Westinghouse Savannah River Co., Aiken, SC (United States). [1992]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE93011779. Source: OSTI; NTIS; INIS; GPO Dep.

The highest stresses in many thin walled piping systems are the local stresses at the pipe supports. These secondary stresses are caused by saddles or other structural discontinuities that restrain pipe ovalization. A static analysis of a thin walled pipe supported on structural steel saddle under dead weight loading is presented. The finite element analysis is performed using a shell model with distributed gravity and hydrostatic pressure loading. Parametric studies on global and local stress are performed to determine the effect of the pipe diameter to thickness ratio. Two aspects of the saddle design are also investigated: the effect of saddle width, and the effect of saddle wrap angle. Additionally, the computed stresses are compared to closed form solutions.

2203 Fuel Elements

Refer also to citation(s) 23154, 23459, 23460, 23547, 23550, 23558, 23559, 23564, 23566, 23567, 23570, 23592, 23593, 24020, 24477

23510 (ANL/FC/CP–77769) **Automated Fuel Element Closure Welding System.** Wahlquist, D.R. Argonne National Lab., Idaho Falls, ID (United States). Fuel Cycle Div. [1993]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-930403–43: 5. topical meeting on robotics and remote systems, Knoxville, TN (United States), 26-29 Apr 1993). Order Number DE93009972. Source: OSTI; NTIS; INIS; GPO Dep.

The Automated Fuel Element Closure Welding System is a robotic device that will load and weld top end plugs onto nuclear fuel elements in a highly radioactive and inert gas environment. The system was developed at Argonne National Laboratory-West as part of the Fuel Cycle Demonstration. The welding system performs four main functions, it (1) injects a small amount of a xenon/krypton gas mixture into specific fuel elements, and (2) loads tiny end plugs into the tops of fuel element jackets, and (3) welds the end plugs to the element jackets, and (4) performs a dimensional inspection of the pre- and post-welded fuel elements. The system components are modular to facilitate remote replacement of failed parts. The entire system can be operated remotely in manual, semi-automatic, or fully automatic modes using a computer control system. The welding system is currently undergoing software testing and functional checkout.

23511 (FEI–2075) **Coefficients of heat transfer through fuel rods for the interchannel heat exchange in the nuclear reactor fuel assemblies.** Mikhin, V.I.; Fetisova, L.N. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk (Russian Federation). Fiziko-Ehnergeticheskij Inst. 1990. [28p.] (In Russian). Order Number DE93626230. Source: OSTI; NTIS (US Sales Only); INIS.

At an irregular rod surface temperature distribution transversal heat flows emerge between the subchannels of the rod bundle of a nuclear reactor because of the rod thermal conductivity. Under certain conditions the contribution of the rod thermal conductivity into heat exchange between subchannels can be dominant. The consistent approach is given for determination of this contribution which is accounted for by the heat transfer coefficients relating heat flows across the rod with subchannel average coolant temperatures. The formulae derived can be used in the rod bundle temperature-field calculations for nuclear reactors. 7 refs.; 5 figs.; 8 tabs.

23512 (FEI–2093) **Statistical modelling of fuel can geometrical characteristics in fuel assemblies of the BN type reactors.** Sopov, O.V. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk (Russian Federation). Fiziko-Ehnergeticheskij Inst. 1990. [12p.] (In Russian). Order Number DE93626231. Source: OSTI; NTIS (US Sales Only); INIS.

To study the regularities of the BN type reactor fuel can distortion a method of statistical modelling has been developed. At the stage of initial data analysis the correlation of within cluster mean and standard deviations has been reduced by dissection of fuel elements profilometry data matrix in terms of the can diameter value for a number of cross sections chosen after preliminary data interpolation. Making use of orthogonal Tchebychev polynomials for the dose - temperature distortion dependence to be described results in decreasing correlation of the model explaining variables. This allows the model parameters to be evaluated by the simple regression analysis methods and ensures the model invariance under a linear transformation of irradiation parameters. 9 refs.; 1 fig.; 1 tab.

23513 (NIIAR–14-797) **Technology of information processing on the complex of primary investigations of fuel assemblies and pins.** Andreev, V.E.; Demeshkin, V.A.; Mal'kov, P.A.; Shimanskij, G.A. Nauchno-Issledovatel'skij Inst. Atomnykh Reaktorov, Dimitrovgrad (Russian Federation). 1990. [14p.] (In Russian). Order Number DE93626233. Source: OSTI; NTIS (US Sales Only); INIS.

The processing problems of non-destructive test results on irradiated fuel pins and assemblies are considered. Scheme of interaction between different levels of information processing system is described. The information was obtained on the complex of primary investigations. The data base structure development is presented for nondestructive test and application package of information in graphical representation. The problems of technology improvement when processing the results on material science experiment are discussed. 5 figs.

23514 (NIIAR–16-799) **Interface device of the IUS/IRPS interfaces for linking of the SM 1634 host computer system with the scales unit.** Zhmajlo, S.A.; Marusev, V.I. Nauchno-Issledovatel'skij Inst. Atomnykh Reaktorov, Dimitrovgrad (Russian Federation). 1990. [12p.] (In Russian). Order Number DE93626410. Source: OSTI; NTIS (US Sales Only); INIS.

Problems of development of the interface device for the TUS/IRPS standard interfaces, which provides two-way information exchange with several users and its introduction into the operational environment of the host computer system of the SM-2 computer architecture are considered. Multiplexer application to the automated control system of the fuel pin production line is described. 5 refs.; 2 figs.; 1 tab.

23515 (WINCO–1112) **Validation of MCNP: SPERT-D and BORAX-V fuel.** Crawford, C.; Palmer, B. Westinghouse Idaho Nuclear Co., Inc., Idaho Falls, ID (United States). Nov 1992. 24p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-84ID12435. Order Number DE93012546. Source: OSTI; NTIS; INIS; GPO Dep.

This report discusses critical experiments involving SPERT-D^{1,2} fuel elements and BORAX-V$^{3-8}$ fuel which have been modeled and calculations performed with MCNP. MCNP is a Monte Carlo based transport code. For this study continuous-energy nuclear data from the ENDF/B-V cross section library was used. The SPERT-D experiments consisted of various arrays of fuel elements

moderated and reflected with either water or a uranyl nitrate solution. Some SPERT-D experiments used cadmium as a fixed neutron poison, while others were poisoned with various concentrations of boron in the moderating/reflecting solution. ne BORAX-V experiments were arrays of either boiling fuel rod assemblies or superheater assemblies, both types of arrays were moderated and reflected with water. In one boiling fuel experiment, two fuel rods were replaced with borated stainless steel poison rods.

2204 Control Systems

Refer also to citation(s) 23606, 23666, 23667

23516 (ANL/RA/CP–78880) **Plant control impact on IFR power plant passive safety response.** Vilim, R.B. Argonne National Lab., IL (United States). Reactor Analysis Div. [1993]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-930401–11: Meeting on nuclear plant instrumentation, control and man-machine interface technologies, Oak Ridge, TN (United States), 18-21 Apr 1993). Order Number DE93009968. Source: OSTI; NTIS; INIS; GPO Dep.

A method is described for optimizing the closed-loop plant control strategy with respect to safety margins sustained in the unprotected upset response of a liquid metal reactor. The optimization is performed subject to the normal requirements for reactor startup, load change and compensation for reactivity changes over the cycle. The method provides a formal approach to the process of exploiting the innate self-regulating property of a metal fueled reactor to make it less dependent on operator action and less vulnerable to automatic control system fault and/or operator error.

23517 (BNL-NUREG–48669) **Classification of alarm processing techniques and human performance issues.** Kim, I.S.; O'Hara, J.M. Brookhaven National Lab., Upton, NY (United States). [1993]. 5p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-930401–16: Meeting on nuclear plant instrumentation, control and man-machine interface technologies, Oak Ridge, TN (United States), 18-21 Apr 1993). Order Number DE93012526. Source: OSTI; NTIS; INIS; GPO Dep.

Human factors reviews indicate that conventional alarm systems based on the one sensor, one alarm approach, have many human engineering deficiencies, a paramount example being too many alarms during major disturbances. As an effort to resolve these deficiencies, various alarm processing systems have been developed using different techniques. To ensure their contribution to operational safety, the impacts of those systems on operating crew performance should be carefully evaluated. This paper briefly reviews some of the human factors research issues associated with alarm processing techniques and then discusses a framework with which to classify the techniques. The dimensions of this framework can be used to explore the effects of alarm processing systems on human performance.

23518 (CONF-930433–8) **Backpropagation architecture optimization and an application in nuclear power plant diagnostics.** Basu, A.; Bartlett, E.B. Iowa State Univ. of Science and Technology, Ames, IA (United States). Dept. of Mechanical Engineering. [1993]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-92ER75700. From 55. annual American power conference; Chicago, IL (United States); 13-15 Apr 1993. Order Number DE93010308. Source: OSTI; NTIS; INIS; GPO Dep.

This paper presents a Dynamic Node Architecture (DNA) scheme to optimize the architecture of backpropagation Artificial Neural Networks (ANNs). This network scheme is used to develop an ANN based diagnostic adviser capable of identifying the operating status of a nuclear power plant. Specifically, a "root" network is trained to diagnose if the plant is in a normal operating condition or not. In the event of an abnormal condition, and other "classifier" network is trained to recognize the particular transient taking place. these networks are trained using plant instrumentation data gathered during simulations of the various transients and normal operating conditions at the Iowa Electric Light and Power Company's Duane Arnold Energy Center (DAEC) operator training simulator.

23519 (DPW–53-1238) **Pin Monitoring System.** Squires, L. Du Pont de Nemours (E.I.) and Co., Wilmington, DE (United States). Explosives Dept. 18 Sep 1953. 1p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. (SR/H–374). Order Number DE93008318. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Short communication. SPECIAL PRODUCTION REACTORS/fuel pins; FUEL PINS/monitoring; REACTOR SAFETY; REACTOR MONITORING SYSTEMS; MONITORING; GEIGER-MUELLER COUNTERS

23520 (DPW–4785) **Control actuators.** Wende, C.W.J. Du Pont de Nemours (E.I.) and Co., Wilmington, DE (United States). 5 Mar 1952. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. (SR/H–494). Order Number DE93011191. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This memorandum provides a discussion of the position-demand feature of the actuators in use. A recommendation is made to review the requirements for accuracy and sensitivity in order to clarify interpretation differences.

23521 (DPW–4864) **Automatic control, 105 reactors.** Overbeek, W.P. Du Pont de Nemours (E.I.) and Co., Wilmington, DE (United States). 14 Mar 1952. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. (SR/H–505). Order Number DE93011202. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This memorandum details meetings to develop a concept for automatic control of the 105 reactors.

23522 (EDF–93-NJ-00002) **Compiling models into real-time systems.** Dormoy, J.L.; Cherriaux, F.; Ancelin, J. Electricite de France (EDF), 92 - Clamart (France). Aug 1992. [13p.] Order Number DE93626238. Source: OSTI; NTIS (US Sales Only); INIS.

This paper presents an architecture for building real-time systems from models, and model-compiling techniques. This has been applied for building a real-time model-base monitoring system for nuclear plants, called KSE, which is currently being used in two plants in France. We describe how we used various artificial intelligence techniques for building it: a model-based approach, a logical model of its operation, a declarative implementation of these models, and original knowledge-compiling techniques for automatically generating the real-time expert system from those models. Some of those techniques have just been borrowed from the literature, but we had to modify or invent other techniques which simply did not exist. We also discuss two important problems, which are often underestimated in the artificial intelligence literature: size, and errors. Our architecture, which could be used in other applications, combines the advantages of the model-based approach with the efficiency requirements of real-time applications, while in general model-based approaches present serious drawbacks on this point.

23523 (EGG-M–92470) **Development of a framework of human-centered automation for the nuclear industry.** Nelson, W.R.; Haney, L.N. EG and G Idaho, Inc., Idaho Falls, ID (United States). [1993]. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-76ID01570. (CONF-930401–14: Meeting on nuclear plant instrumentation, control and man-machine interface technologies, Oak Ridge, TN (United States), 18-21 Apr 1993). Order Number DE93010789. Source: OSTI; NTIS; INIS; GPO Dep.

Introduction of automated systems into control rooms for advanced reactor designs is often justified on the basis of increased efficiency and reliability, without a detailed assessment of how the new technologies will influence the role of the operator. Such a "technology-centered" approach carries with it the risk that entirely new mechanisms for human error will be introduced, resulting in some unpleasant surprises when the plant goes into operation. The aviation industry has experienced some of these surprises since the introduction of automated systems into the cockpits of advanced technology aircraft. Pilot errors have actually been induced by automated systems, especially when the pilot doesn't fully understand what the automated systems are doing during all modes of operation. In order to structure the research program for investigating these problems, the National Aeronautics and Space

Administration (NASA) has developed a framework for human-centered automation. This framework is described in the NASA document Human-Centered Aircraft Automation Philosophy by Charles Billings. It is the thesis of this paper that a corresponding framework of human-centered automation should be developed for the nuclear industry. Such a framework would serve to guide the design and regulation of automated systems for advanced reactor designs, and would help prevent some of the problems that have arisen in other applications that have followed a "technology-centered" approach.

23524 (FEI–2113) **Properties of bilinear functionals in reactor systems and reactivity increment calculation.** Korobejnikov, V.V.; Petrov, Eh.E. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk (Russian Federation). Fiziko-Ehnergeticheskij Inst. 1990. [19p.] (In Russian). Order Number DE93626239. Source: OSTI; NTIS (US Sales Only); INIS.

At last time the bilinear integral functionals over closed surface including direct and adjoint functions of radiation flux, are used for solving neutron transport problem in reactor systems. An attempt to study the properties of the bilinear functional on the exluzive surface and derive the equations for the calculation of reactivity changing is made. The comparison of experiments and calculations are discussed. 5 refs.; 5 figs.; 1 tab.

23525 (INIS-mf–13502, pp. 183-197) **Trends in information processing and configuration of plant automation.** Fischer, H.D. (Siemens AG/KWU R2, Erlangen (Germany)). European Nuclear Society (ENS), Bern (Switzerland); Czech Nuclear Society, Prague (Czech Republic); Slovak Nuclear Society, Bratislava (Slovakia). Jan 1993. (CONF-921068–: East-West topical meeting: the safe and reliable operation of light water reactor NPP's, Prague (Czechoslovakia), 18-21 Oct 1992). In *Topform '92: the safe and reliable operation of LWR NPPs. Vol. I: Invited plenary session papers.* [235p.] Order Number DE93626240. Source: OSTI; NTIS (US Sales Only); INIS.

A brief review is given of the most promising ways of information processing with respect to plant diagnoses in a digital I and C environment. For such an I and C system the configuration of plant automation is presented to give recommendations particularly for retrofitting existing nuclear power plants. (author) 7 figs., 4 refs.

23526 (INIS-mf–13503, pp. 187-190) **Digital nuclear instrumentation application to nuclear power plant.** Burel, J.-P. (Merlin Gerin, Grenoble (France). Departement Systemes et Electronique de Surete); Fanet, H. European Nuclear Society (ENS), Bern (Switzerland); Czech Nuclear Society, Prague (Czech Republic); Slovak Nuclear Society, Bratislava (Slovakia). Jan 1993. (CONF-921068–: East-West topical meeting: the safe and reliable operation of light water reactor NPP's, Prague (Czechoslovakia), 18-21 Oct 1992). In *Topform '92: the safe and reliable operation of LWR NPPs. Vol. II: Poster papers.* [245p.] Order Number DE93625345. Source: OSTI; NTIS (US Sales Only); INIS.

The use of digital techniques for the control of nuclear reactors offers an interesting prospect in the improvement of the operation and safety of reactors. Thanks to close collaboration between Merlin Gerin and the French Atomic Energy Commission, a new piece of technology for nuclear instrumentation systems has been developed in order to meet the needs of different types of reactors. The principles of measurement are presented and the technology used is described. Other interesting points of this technology in addition to installation, operation and safety are examined. The digital neutron measurements are already operating in research reactors in France and will be installed in a different configuration in the new 1400 MW nuclear power plant. Integration into different designs is easily attainable by adapting the information transmission mode according to the technology present in the protection system and the treatment and visualization systems. (author).

23527 (INIS-mf–13503, pp. 191-194) **An investigation of axial xenon stability in WWER-1000 reactor designs.** Doshi, P.K. (Westinghouse Electric Corp., Pittsburgh, PA (United States)); Miller, R.W. European Nuclear Society (ENS), Bern (Switzerland); Czech Nuclear Society, Prague (Czech Republic); Slovak Nuclear Society, Bratislava (Slovakia). Jan 1993. (CONF-921068–: East-West topical meeting: the safe and reliable operation of light water reactor NPP's, Prague (Czechoslovakia), 18-21 Oct 1992). In *Topform '92: the safe and reliable operation of LWR NPPs. Vol. II: Poster papers.* [245p.] Order Number DE93625345. Source: OSTI; NTIS (US Sales Only); INIS.

The nuclear power plants of the WWER-1000 design have experienced frequent xenon oscillation control problems. In most PWRs, xenon oscillations are largely a problem in the axial direction. An one dimensional core model representative of the WWER-1000 design was set up to examine the controllability of the current design. An investigation of possible improvements to this design was made. There was no indication that xenon oscillations were an inherent problem in WWER-1000 core design. Simple changes to the control rod system coupled with a sound power distribution control strategy that has been proven to be an effective but simple procedure to follow, eliminate xenon control problems. The changes proposed can be implemented in a very cost effective manner. There are no equipment changes needed, existing control rods can be used. Only software changes are required. (Z.S.) 1 tab., 2 figs., 7 refs.

23528 (INIS-mf–13503, pp. 238-241) **Digital I and C for nuclear power plant.** Gemst, P. van (ABB Atom AB, Vaesteraas (Sweden)). European Nuclear Society (ENS), Bern (Switzerland); Czech Nuclear Society, Prague (Czech Republic); Slovak Nuclear Society, Bratislava (Slovakia). Jan 1993. (CONF-921068–: East-West topical meeting: the safe and reliable operation of light water reactor NPP's, Prague (Czechoslovakia), 18-21 Oct 1992). In *Topform '92: the safe and reliable operation of LWR NPPs. Vol. II: Poster papers.* [245p.] Order Number DE93625345. Source: OSTI; NTIS (US Sales Only); INIS.

A summary is given of the past experience (process I and C, digital controllers, Power Range Monitoring system) and future plans (integrated plant I and C, control room) of ABB Atom for programmable I and C at nuclear power plants. ABB Atom has designed and supplied an appreciable quantity of software based equipment for nuclear power plants. These have been supplied for both new plants as well as for backfitting. The well proven ABB Master system has been used for the supply of I and C equipment for these projects and will continue to be used in the future. (Z.S.) 1 fig.

23529 (JAERI-M–93-041) **Study on statistical analysis of nonlinear and nonstationary reactor noises.** Hayashi, Koji (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Tokai Research Establishment). Japan Atomic Energy Research Inst., Tokyo (Japan). Mar 1993. 160p. (In Japanese). Order Number DE93797604. Source: OSTI; NTIS; INIS.

For the purpose of identification of nonlinear mechanism and diagnosis of nuclear reactor systems, analysis methods for nonlinear reactor noise have been studied. By adding newly developed approximate response function to GMDH, a conventional nonlinear identification method, a useful method for nonlinear spectral analysis and identification of nonlinear mechanism has been established. Measurement experiment and analysis were performed on the reactor power oscillation observed in the NSRR installed at the JAERI and the cause of the instability was clarified. Furthermore, the analysis and data recording methods for nonstationary noise have been studied. By improving the time resolution of instantaneous autoregressive spectrum, a method for monitoring and diagnosis of operational status of nuclear reactor has been established. A preprocessing system for recording of nonstationary reactor noise was developed and its usability was demonstrated through a measurement experiment. (author) 139 refs.

23530 (LIYaF–1597) **On boiling out of the PIK reactor liquid regulator in the case of the emergency.** Kislitsyn, B.V.; Konoplev, K.A.; Smol'skij, S.L. AN SSSR, Leningrad (Russian Federation). Inst. Yadernoj Fiziki. Apr 1990. [27p.] (In Russian). Order Number DE93626241. Source: OSTI; NTIS (US Sales Only); INIS.

The process of heating and boiling out of the liquid regulator from circular clearance of the PIK reactor vessel in the case of emergency is considered. The time of freeing the circular clearance volume from the absorber was calculated. Balance of the reactivity for safety reactor stopping is considered. The maximum permitted time for operation of the emergency protection is estimated. 4 refs.; 11 figs.; 2 tabs.

23531 (NUREG/CR–6018) **Survey and assessment of conventional software verification and validation methods.** Miller, L.A. (Science Applications International Corp., Reston, VA (United States)); Groundwater, E.; Mirsky, S.M. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Systems Research; Science Applications International Corp., Reston, VA (United States). Apr 1993. 184p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). (EPRI-TR–102106;SAIC–91/6660). Source: OSTI; NTIS; INIS; GPO.

By means of a literature survey, a comprehensive set of methods was identified for the verification and validation of conventional software. The 134 methods so identified were classified according to their appropriateness for various phases of a developmental lifecycle – requirements, design, and implementation; the last category was subdivided into two, static testing and dynamic testing methods. The methods were then characterized in terms of eight rating factors, four concerning ease-of-use of the methods and four concerning the methods' power to detect defects. Based on these factors, two measurements were developed to permit quantitative comparisons among methods, a Cost-Benefit metric and an Effectiveness Metric. The Effectiveness Metric was further refined to provide three different estimates for each method, depending on three classes of needed stringency of V&V (determined by ratings of a system's complexity and required-integrity). Methods were then rank-ordered for each of the three classes in terms of their overall cost-benefits and effectiveness. The applicability was then assessed of each method for the four identified components of knowledge-based and expert systems, as well as the system as a whole.

23532 (ORNL/FTR–4259) **Travel to Japan to present lecture on ORNL/CESAR intelligent machines research and development at the International Specialists meeting on artificial intelligence and robotics for nuclear power plants (AIR'92): Foreign trip report, May 17–27, 1992.** Mann, R.C. Oak Ridge National Lab., TN (United States). 12 Jun 1992. 22p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93011078. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This trip report describes travel to participate in the Specialist Meeting on Applications of Artificial Intelligence and Robotics in Nuclear Power Plants - AIR'92, and presentation of an invited paper on related research and development activities at the ORNL Center for Engineering Systems Advanced Research (CESAR).

23533 (ORNL/FTR–4390) **[Nuclear reactor surveillance and diagnostics in France]: Foreign trip report, September 19–23, 1992.** Kryter, R.C. Oak Ridge National Lab., TN (United States). 5 Oct 1992. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93011741. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The first meeting of the Working Party on Surveillance and Diagnostics (WPSD) was held on September 21 and 22, 1992 at the Nuclear Energy Agency's (NEA's) new headquarters at Issy-les-Moulineaux, Paris. This Working Party, consisting of 19 experts in the field of nuclear reactor surveillance and diagnostics/in-core measurements and representing 12 Organization for Economic Cooperation and Development (OECD) member countries, was created at the November 1991 meeting of the NEA Nuclear Science Committee (NSC) and charged with (1) reviewing the current state of the art in the two somewhat related areas of plant fault detection/diagnosis and core performance/safety assessment, (2) identifying technical issues worthy of attention, (3) proposing Specialists' Meetings and/or symposia (as appropriate) to address these unresolved issues, and (4) proposing Benchmark Problems that could help delineate the relative strengths and weaknesses of alternative methods of analysis currently in use. Extensive discussion, the WPSD addressed and closed out all four of its assigned tasks with the following actions/recommendations: (1) selected WPSD members were assigned the responsibility to prepare (within 30 days) short state-of-the-art updates in 12 technical areas of identified need (see body of this FIR for details); (2) WPSD voted to recommend to NEA/NSC that Specialists' Meetings on in-core measurements and open symposia (continuing the SMORN series) on reactor surveillance and diagnostics continue to be held on a 4-year time interval, but with the schedules for the two types of meeting staggered by at least one year; and (3) WPSD voted to recommend to NEA/NSC that Benchmark Problems be pursued in the following three areas: neural networks/pattern recognition algorithms for data classification, loose-part monitoring/analyis techniques, and BWR stability analysis/prediction techniques.

23534 (RI–214) **Experimental and computation method for determination of burnup and isotopic composition of the WWER-440 fuel using the ^{134}Cs and ^{137}Cs concentrations.** Babichev, B.A.; Kozharin, V.V. Radievyj Inst., Leningrad (Russian Federation). 1990. [25p.] (In Russian). Order Number DE93626242. Source: OSTI; NTIS (US Sales Only); INIS.

An experimental and computational method for determination of burnup and actinoid concentrations in WWER fuel elements using ^{134}Cs and ^{137}Cs concentrations in fuel is considered. It is shown that the error in calculation of fuel burnup and U and Pu isotope concentrations in WWER-440 fuel elements is 1.3-4.9% provided that the error in ^{134}Cs and ^{137}Cs concentration measurements does not exceed 1.7 and 1.2%. 9 refs.; 10 figs.; 4 tabs.

23535 (UCRL-CR–109416) **Formal methods in the development of safety critical software systems: Version 3.0.** Williams, L.G. (Software Engineering Research, Boulder, CO (United States)). Lawrence Livermore National Lab., CA (United States); Software Engineering Research, Boulder, CO (United States). Apr 1992. 22p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE93012314. Source: OSTI; NTIS; GPO Dep.

As the use of computers in critical control systems such as aircraft controls, medical instruments, defense systems, missile controls, and nuclear power plants has increased, concern for the safety of those systems has also grown. Much of this concern has focused on the software component of those computer-based systems. This is primarily due to historical experience with software systems that often exhibit larger numbers of errors than their hardware counterparts and the fact that the consequences of a software error may endanger human life, property, or the environment. A number of different techniques have been used to address the issue of software safety. Some are standard software engineering techniques aimed at reducing the number of faults in a software protect, such as reviews and walkthroughs. Others, including fault tree analysis, are based on identifying and reducing hazards. This report examines the role of one such technique, formal methods, in the development of software for safety critical systems. The use of formal methods to increase the safety of software systems is based on their role in reducing the possibility of software errors that could lead to hazards.

23536 (UCRL-ID–108725) **Techniques, processes, and measures for software safety and reliability: Version 3.0.** Sparkman, D. Lawrence Livermore National Lab., CA (United States). 30 May 1992. 55p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE93012379. Source: OSTI; NTIS; INIS; GPO Dep.

The purpose of this report is to provide a detailed survey of current recommended practices and measurement techniques for the development of reliable and safe software-based systems. This report is intended to assist the United States Nuclear Reaction Regulation (NRR) in determining the importance and maturity of the available techniques and in assessing the relevance of individual standards for application to instrumentation and control systems in nuclear power generating stations. Lawrence Livermore National Laboratory (LLNL) provides technical support for the Instrumentation and Control System Branch (ICSB) of NRRin advanced instrumentation and control systems, distributed digital systems, software reliability, and the application of verificafion and validafion for the development of software.

23537 (WSRC-TR–92-547) **GRISET certification package: Revision 2.** Taylor, J.J.; Cefus, G.R. Westinghouse Savannah River Co., Aiken, SC (United States). Nov 1992. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE93011783. Source: OSTI; NTIS; GPO Dep.

The GRISET (GRIMHX setup) computer code is an input driver for the three dimensional G computer code (Reference 4). GRISET provides a method for automating the creation of G geometry and associated problem specific information such as the reactor maps and the cross section data references. GRISET provides methods which allow the user to model control rod positioning, safety rod insertion with any number failing, control rod withdrawal or insertion, and full or partial melting of control rods. GRISET also calculates the radial shape factor, tilt, roof-top-ratios, and the assembly power peaking.

2205 Environmental Aspects

Refer also to citation(s) 23605, 24873, 24908

23538 (BNWL-CC–1410) **An analysis of the behavior of arsenic in Hanford reactor systems.** Divine, J.R.; Nielson, W.H. Battelle-Northwest, Richland, WA (United States). Pacific Northwest Lab. 31 Oct 1967. 38p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93012049. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The origin of the radioactive materials in the effluent cooling water from the production reactors at Hanford has been the subject of much study. Interest in these materials is generated both by their tendency to accumulate in rear-face piping, with a consequent radiation hazard to the operating personnel, and by the potential contamination of the Columbia River into which the reactor coolant is ultimately discharged. This report describes the present state of development and understanding of this problem. Herein we have compared experimental results with those predicted by the model to determine the deficiencies of the model.

23539 (DOE-RAS–92.006) **Environmental radioactivity from Chernobyl.** Garland, J.A. (AEA Environment and Energy, Harwell (United Kingdom)). Department of the Environment, London (United Kingdom). Radioactive Substances Div. 1992. [22p.] Contract PECD-7/9/359. Order Number DE93625789. Source: OSTI; NTIS (US Sales Only); INIS.

A broadly based programme of environmental measurements following the Chernobyl accident is summarised and discussed. Levels of radionuclides in air and atmospheric deposition were increased substantially for a period of some weeks following the accident. The quantity of ^{137}Cs in surface soils was doubled in some regions of the North and West of the UK. Observations of the rates of deposition and resuspension, and weathering from grass, a river catchment and buildings, provided confirmation of several aspects of the environmental behaviour of ^{137}Cs, and extended understanding of these processes. Levels of ^{137}Cs in imported crops and in individuals in S. England, and the brief increase in external radiation, were generally low, confirming that the dose to the regional population was small. (author).

23540 (DPW–3990) **Suggested program for decontamination studies.** Pohl, H.A. Du Pont de Nemours (E.I.) and Co., Wilmington, DE (United States). 5 Dec 1951. 2p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. (SR/H–449). Order Number DE93011144. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This memorandum lists program items which are suggested for consideration in the proposed ANL study of decontaminating systems containing the product of ruptured U slugs in water.

23541 (DPW–4408) **Decontamination of Savannah piles.** Pohl, H.A. Du Pont de Nemours (E.I.) and Co., Wilmington, DE (United States). 18 Jan 1952. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. (SR/H–433). Order Number DE93011126. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This memorandum provides a clearly defined picture of the methods in which the Savannah piles should be decontaminated. These methods were developed at a conference at Argonne National Laboratory (ANL).

23542 (DUN–3259) **Program review: Ground disposal of reactor effluent.** Geier, R.G. Douglas United Nuclear, Inc., Richland, WA (United States). 18 Oct 1967. 44p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93012155. Source: OSTI; NTIS (US Sales Only); GPO Dep.

With the exception of N Reactor the plutonium production reactors operated by Douglas United Nuclear, Inc., use treated Columbia River water as coolant on a once through basis. Thus, radionuclides formed by neutron activation of Columbia River salts not removed in the water treatment process and water treatment additives are discharged to the river. Although the quantity and possible effects of the radionuclides released are well within nationally accepted limits, emphasis has been placed for some time on reducing the releases to as low a level as possible. More recently increasing concern has been evidenced with regard to the heat which is also discharged to the river. This report discusses concept which not only would drastically reduce the radionuclide content of the river but which would also substantially decrease the heat discharge. This concept is the disposal of the reactor effluent to the ground either to a pond or to a network of trenches.

23543 (DUN–7521) **Radioactive effluent control program: Douglas United Nuclear operated AEC facilities.** Bolliger, J.R. (ed.). Douglas United Nuclear, Inc., Richland, WA (United States). 25 Jan 1971. 25p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93012064. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report is addressed to the radioactive effluent control program of (AEC) facilities operated by Douglas United Nuclear, Inc. It was prepared in response to an inquiry from Atomic Energy Commision AEC Division of Operational Safety via AEC-RL regarding quantities of radionuclides released. The current status, measurement, and activity of the program are described. In addition, other related efforts which have been deferred due to lack of funding are highlighted.

23544 (GSF–33/91) **Establishment of a real-time electronic expert system to estimate and limit radiological consequences of nuclear facility accidents in the Federal Republic of Germany. Final report.** Jacob, P. (GSF - Forschungszentrum fuer Umwelt und Gesundheit GmbH, Neuherberg (Germany). Inst. fuer Strahlenschutz); Eklund, J.; Gregor, J.; Mueller, H.; Paretzke, H.G.; Proehl, G.; Richter, M.; Stapel, R. GSF - Forschungszentrum fuer Umwelt und Gesundheit GmbH, Neuherberg (Germany); Bundesministerium fuer Umwelt, Naturschutz und Reaktorsicherheit, Bonn (Germany). Dec 1991. 223p. (In German). Contract BMU St.Sch. 1073. Order Number DE93795220. Source: OSTI; NTIS (US Sales Only); INIS.

Also published as report BMU–1992-330.

The programme system PARK is mainly based on the radioecological food chain model ECOSYS. PARK is subdivided into the system parts AUTOPARK and DIAPARK, and into the programme DOSISPARK. AUTOPARK is a mainly automatically running programme system which converts the measured data obtained by intensive operation of the 'Integrated measuring and information system for monitoring environmental radioactivity in the Federal Republic of Germany (IMIS)', and the propagation calculations provided by the German Weather Service, into a full-scale assessment of nuclide-specific contamination of air, soil and 20 plant species. Based on such calculation results, the potential radiation exposures of the public are assessed, the expected contamination of food is prognosticated, and the effects of the preventive measures 'recommendation of staying indoors' and 'prohibition of marketing higher-level contaminated food' are investigated for ten relevant radionuclides. (orig.).

23545 (NUREG/CR–4214-Rev.1-Pt.2-Add.2) **Health effects models for nuclear power plant accident consequence analysis: Modification of models resulting from addition of effects of exposure to alpha-emitting radionuclides: Revision 1, Part 2, Scientific bases for health effects models, Addendum 2.** Abrahamson, S. (Wisconsin Univ., Madison, WI (United States)); Bender, M.A.; Boecker, B.B.; Scott, B.R.; Gilbert, E.S. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Regulatory Applications; Lovelace Biomedical and Environmental Research Inst., Albuquerque, NM (United States). Inhalation Toxicology Research Inst.; Wisconsin Univ., Madison, WI (United

States); Brookhaven National Lab., Upton, NY (United States); Pacific Northwest Lab., Richland, WA (United States). May 1993. 71p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC04-76DP00789. (LMF–136). Source: OSTI; NTIS; INIS; GPO.

The Nuclear Regulatory Commission (NRC) has sponsored several studies to identify and quantify, through the use of models, the potential health effects of accidental releases of radionuclides from nuclear power plants. The Reactor Safety Study provided the basis for most of the earlier estimates related to these health effects. Subsequent efforts by NRC-supported groups resulted in improved health effects models that were published in the report entitled "Health Effects Models for Nuclear Power Plant Consequence Analysis", NUREG/CR-4214, 1985 and revised further in the 1989 report NUREG/CR-4214, Rev. 1, Part 2. The health effects models presented in the 1989 NUREG/CR-4214 report were developed for exposure to low-linear energy transfer (LET) (beta and gamma) radiation based on the best scientific information available at that time. Since the 1989 report was published, two addenda to that report have been prepared to (1) incorporate other scientific information related to low-LET health effects models and (2) extend the models to consider the possible health consequences of the addition of alpha-emitting radionuclides to the exposure source term. The first addendum report, entitled "Health Effects Models for Nuclear Power Plant Accident Consequence Analysis, Modifications of Models Resulting from Recent Reports on Health Effects of Ionizing Radiation, Low LET Radiation, Part 2: Scientific Bases for Health Effects Models," was published in 1991 as NUREG/CR-4214, Rev. 1, Part 2, Addendum 1. This second addendum addresses the possibility that some fraction of the accident source term from an operating nuclear power plant comprises alpha-emitting radionuclides. Consideration of chronic high-LET exposure from alpha radiation as well as acute and chronic exposure to low-LET beta and gamma radiations is a reasonable extension of the health effects model.

23546 (WSRC-TR–92-261) **A model for radionuclide transport in the Cooling Water System.** Kahook, S.D. Westinghouse Savannah River Co., Aiken, SC (United States). Aug 1992. 73p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE93012149. Source: OSTI; NTIS; INIS; GPO Dep.

A radionuclide transport model developed to assess radiological levels in the K-reactor Cooling Water System (CWS) in the event of an inadvertent process water (PW) leakage to the cooling water (CW) in the heat exchangers (HX) is described. During and following a process water leak, the radionuclide transport model determines the time-dependent release rates of radionuclide from the cooling water system to the environment via evaporation to the atmosphere and blow-down to the Savannah River. The developed model allows for delay times associated with the transport of the cooling water radioactivity through cooling water system components. Additionally, this model simulates the time-dependent behavior of radionuclides levels in various CWS components. The developed model is incorporated into the K-reactor Cooling Tower Activity (KCTA) code. KCTA allows the accident (heat exchanger leak rate) and the cooling tower blow-down and evaporation rates to be described as time-dependent functions. Thus, the postulated leak and the consequence of the assumed leak can be modelled realistically. This model is the first of three models to be ultimately assembled to form a comprehensive Liquid Pathway Activity System (LPAS). LPAS will offer integrated formation, transport, deposition, and release estimates for radionuclides formed in a SRS facility. Process water and river water modules are forthcoming as input and downstream components, respectively, for KCTA.

2206 Research, Test, Training, Production, Irradiation, Materials Testing Reactors

Refer also to citation(s) 22878, 23129, 23486, 23519, 23520, 23521, 23530, 23538, 23540, 23541, 23542, 23543, 23546, 23618, 23619, 23620, 23621, 23630, 23631, 23632, 23633, 23637, 23669, 23671, 23672, 23678, 23679, 23680, 23681, 23682, 23684, 23685, 23686, 23687, 23960, 23962, 24022, 24024, 24820, 24821, 24873, 24908

23547 (ANL/NPR–93/4) **Analysis of fission gas behavior and foaming of molten uranium- aluminum alloy fuel for nuclear reactors: New Production Reactors Program.** Gruber, E.E.; Kramer, J.M. Argonne National Lab., IL (United States). Sep 1990. 25p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. Order Number DE93010625. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report begins with a review of the models selected to analyze fission-gas foaming in molten U-Al alloy fuel for nuclear reactors. The models were incorporated into the FRAS/FOAM code for initial testing and scoping calculations. The FRAS/FOAM calculations were verified by comparing the results for a simplified problem to analytical results. The molten-fuel models were then incorporated into the FRAS3 code for further model developments that extend the analysis into the foaming regime for molten U-Al fuel. The most significant of the new models is the one for bubble sweeping, which extends the earlier pair-wise coalescence model to conditions appropriate for foaming to occur. Results are presented that indicate foaming can occur on time scales as short as 10 to l00ms after melting begins. The dependence of the timing and potential amount of foaming on the pressure and fuel burnup are also presented. A number of assumptions applied in these calculations, however, tend to overestimate the rate of bubble coalescence and growth. Directions for further work in this modeling effort are described. They include incorporation of a fuel-melting model into the FRAS3 code, so that a two-field calculation of melting fuel can be carried out.

23548 (BNWL-CC–1410-Suppl.) **An analysis of the behavior of arsenic in Hanford reactor systems.** Divine, J.R. Battelle-Northwest, Richland, WA (United States). Pacific Northwest Lab. Dec 1967. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93012050. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report provides an analysis and experimental data on arsenic in the reactor cooling system.

23549 (CONF-930803–8) **Pipe break testing of primary loop piping similar to Department of Energy's New Production Reactor-Heavy Water Reactor.** Poole, A.B.; Clinard, J.A.; Battiste, R.L.; Hendrich, W.R. Oak Ridge National Lab., TN (United States). [1993]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 12. biennial conference for the International Association for Structural Mechanics in Reactor Technology; Stuttgart (Germany); 16-20 Aug 1993. Order Number DE93011863. Source: OSTI; NTIS; INIS; GPO Dep.

The subject of this paper is to review the recent failure testing of the Savannah River C-reactor piping weldment, which will be referred to as the C-pipe in the remainder of the paper. The intent of this paper is to further familiarize the technical community with Oak Ridge National Laboratory's (ORNL) pipe test program and associated activities surrounding the C-pipe test as conducted on behalf of the Department of Energy New Production Reactor (DOE-NPR) Program.

23550 (CONF-930830–6) **Experimental investigation of thermal limits in parallel plate configuration for the Advanced Neutron Source Reactor.** Siman-Tov, M.; Felde, D.K.; Kaminaga, M.; Yoder, G.L. Oak Ridge National Lab., TN (United States). [1993]. 37p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From National conference and exposition on heat transfer; Atlanta, GA (United States); 8-11 Aug 1993. Order Number DE93008274. Source: OSTI; NTIS; INIS; GPO Dep.

The Advanced Neutron Source Reactor (ANSR) is currently being designed to become the world's highest-flux, steady-state, thermal neutron source for scientific experiments. Highly subcooled, heavy-water coolant flows vertically upward at a very high velocity of 25 m/s through parallel aluminum fuel-plates. The core has average and peak heat fluxes of 5.9 and 12 MW/m^2, respectively. In this configuration, both flow excursion (FE) and true critical heat flux (CHF), represent potential thermal limitations. The availability of experimental data for both FE and true CHF at the

conditions applicable to the ANSR is very limited. A Thermal Hydraulic Test Loop (THTL) facility was designed and built to simulate a full-length coolant subchannel of the core, allowing experimental determination of both thermal limits under the expected ANSR T/H conditions. A series of FE tests with water flowing vertically upward was completed over a nominal heat flux range of 6 to 14 MW/m^2 and a corresponding velocity range of 8 to 21 m/s. Both the exit pressure (1.7 MPa) and inlet temperature (45°C) were maintained constant for these tests, while the loop was operated in a "stiff"(constant flow) mode. Limited experiments were also conducted at 12 MW/m^2 using a "soft" mode (near constant pressure-drop) for actual FE burnout tests and using a "stiff' mode for true CHF tests, to compare with the original FE experiments.

23551 (DOE/ER/75728–1) **Support of nuclear engineering education and research at the University of Michigan: Progress report, May 15, 1992–May 14, 1993.** Martin, W.R. Michigan Univ., Ann Arbor, MI (United States). Dept. of Nuclear Engineering. Mar 1993. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-92ER75728. Order Number DE93012987. Source: OSTI; NTIS; INIS; GPO Dep.

This report describes progress on four different projects in the fission reactor area that have been supported by the grant during the past year. These projects are: Accelerator transmutation of nuclear waste (Steve Pearson); neutronic analysis of the Ford Nuclear Reactor (Brent Renkema); developing Monte Carlo benchmarks for commercial LWR configurations (Jie Du); Monte Carlo depletion capability for massively parallel processors (Amit Majumdar); these tasks are briefly described and progress to date is presented.

23552 (DOE/ER/75729–1) **Nuclear Power Engineering Education Program, University of Illinois: Progress report, May 15, 1992–March 31, 1993.** Jones, B.G. Illinois Univ., Urbana, IL (United States). [1993]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-92ER75729. Order Number DE93012808. Source: OSTI; NTIS; INIS; GPO Dep.

The DOE/CECo Nuclear Power Engineering Education Program at the University of Illinois in its first year has significantly impacted the quality of the power education which our students receive. It has contributed to: the recently completed upgrade of the console of our Advanced TRIGA reactor which increases the reactor's utility for training, the procurement of new equipment to upgrade and refurbish several of the undergraduate laboratory set-ups, and the procurement of computational workstations in support of the instructional computing laboratory. In addition, smaller amounts of funds were used for the recruitment and retention of top quality graduate students, the support of faculty to visit other institutions to attract top students into the discipline, and to provide funds for faculty to participate in short courses to improve their skills and background in the power area. These items and activities have helped elevate in the student's perspective the role of nuclear power in the discipline. We feel this is having a favorable impact on student career selection and on ensuring the continued supply of well educated nuclear engineering graduates.

23553 (DPW–53-3-1) **[Report on construction progress of the Explosives Department at the Savannah River Plant].** List, J.A. Du Pont de Nemours (E.I.) and Co., Wilmington, DE (United States). 7 Jan 1953. 2p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. (SR/H–512). Order Number DE93012040. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Short communication. HEAT EXCHANGERS/procurement; SPECIAL PRODUCTION REACTORS/heat exchangers; SAVANNAH RIVER PLANT; PROCUREMENT; CONSTRUCTION; C REACTOR; REACTOR COOLING SYSTEMS; ENGINEERING

23554 (DPW–53-3-3) **[Budgetary concerns for construction of the Explosives Department at the Savannah River Plant].** List, J.A. Du Pont de Nemours (E.I.) and Co., Wilmington, DE (United States). 23 Jan 1953. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. (SR/H–513). Order Number DE93012041. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Short communication. SAVANNAH RIVER PLANT/budgets; SPECIAL PRODUCTION REACTORS; BUDGETS; CONSTRUCTION; ROADS; BUILDINGS; ENGINEERING; FUEL ELEMENTS

23555 (DPW–53-3-4) **[Progress of construction of critical facilities at Savannah River's Explosives Department].** List, J.A. Du Pont de Nemours (E.I.) and Co., Wilmington, DE (United States). 20 Feb 1953. 2p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. (SR/H–514). Order Number DE93012042. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Short communication. SPECIAL PRODUCTION REACTORS/design; SAVANNAH RIVER PLANT; DESIGN; BUILDINGS; FUEL ELEMENTS; CONSTRUCTION

23556 (DPW–53-3-5) **[Construction concerns for the 100-C Area at Savannah River].** List, J.A. Du Pont de Nemours (E.I.) and Co., Wilmington, DE (United States). 6 Mar 1953. 2p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. (SR/H–515). Order Number DE93012043. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Short communication. SPECIAL PRODUCTION REACTORS/design; SAVANNAH RIVER PLANT; FUEL ELEMENTS; TANKS; BUILDINGS; ENGINEERING; L REACTOR; K REACTOR; MODIFICATIONS; DESIGN; PURIFICATION

23557 (DPW–53-3-11) **[Minutes of meeting of Atomic Energy Division, Engineering Department, Explosives Department].** List, J.A. Du Pont de Nemours (E.I.) and Co., Wilmington, DE (United States). 24 Jul 1953. 2p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. (SR/H–519). Order Number DE93012047. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report documents discussion at a meeting concerning the construction of the Explosives Department at the Savannah River Plant.

23558 (DPW–53-1232) **Weekly report, September 7–11, 1953, Sylvania Electric Products Company (25730-700).** Gamel, C.M. Jr. Du Pont de Nemours (E.I.) and Co., Wilmington, DE (United States). Explosives Dept. 14 Sep 1953. 2p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. (SR/H–373). Order Number DE93008317. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This weekly report discusses progress by Sylvania Electric Products Company in the production of powder metal flat plates.

23559 (DPW–53-1430) **[Progress on chromium barrier layers for extended surface fuel elements]: Trip report, November 18, 1953.** Pocalyko, A. Du Pont de Nemours (E.I.) and Co., Wilmington, DE (United States). 11 Dec 1953. 2p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. (SR/H–402). Order Number DE93010101. Source: OSTI; NTIS (US Sales Only); GPO Dep.

In addition to depositing chromium barrier layers on uranium strip by their pack-carburizing type technique NRC was requested and agreed to submit for AED evaluation chromium coatings prepared by a vacuum thermal evaporation process. Coatings produced by the latter method will be subsequently heat-treated in an attempt to improve corrosion resistance in boiling distilled water.

23560 (DPW–3694) **[Travel to the Lummus Company, New York City for review of Heat Exchanger Tube Sheet Design, Savannah River Plant, 400D Area]: Trip report, October 23, 1951.** Kuhn, B.D. Du Pont de Nemours (E.I.) and Co., Wilmington, DE (United States). 2 Nov 1951. 2p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. (SR/H–473). Order Number DE93011170. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This memorandum details a visit to the Lummus company in New York City on October 23rd, 1951 to discuss the design of the C.F. Braun company's heat exchanger tube sheets.

23561 (DPW–3720) **100 Area, water requirements.** Bellas, H.W. Du Pont de Nemours (E.I.) and Co., Wilmington, DE (United States). 6 Nov 1951. 2p. Sponsored by USDOE, Washington, DC

(United States). DOE Contract AC09-76SR00001. (SR/H–480). Order Number DE93011177. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This memorandum provides a summary of latest thinking on 100 Area water flows and requirements. Filtered, service, and cooling water demands are tabulated.

23562 (DPW–3816) **[Heat exchangers for Savannah River Reactors].** Johnson, A.A. Du Pont de Nemours (E.I.) and Co., Wilmington, DE (United States). Explosives Dept. 15 Nov 1951. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. (SR/H–406). Order Number DE93010105. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This memorandum provides information developed on heat exchangers for the Savannah River Piles. Discussed in the sections that follows are current design of heat exchangers and coolant circulating system, general considerations that led to this design and are alternate designs that were considered.

23563 (DPW–3909) **[Travel to Argonne National Laboratory for discussions concerning ZPR-2]: Trip report, November 15, 1951.** Dessauer, G. Du Pont de Nemours (E.I.) and Co., Wilmington, DE (United States). 26 Nov 1951. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. (SR/H–453). Order Number DE93011148. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This memorandum details a visit to Argonne National Laboratory (ANL) on November 15, 1951. The following items were discussed: Progress on ZPR-2 in general; Procedures for removing control assemble for handling fuel tubes; Control actuator, control ganging, and annunciator design; Collaboration between ANL Physics Division and ZPR-2 crew; Experimental program - Liaison with du Pont.

23564 (DPW–3989) **[Travel to Monsanto to discuss the problem of decontaminating the cave in the disassembly area in the event of 5Y3 slug rupture]: Trip report, November 21, 1951.** Langhaar, J.W. Du Pont de Nemours (E.I.) and Co., Wilmington, DE (United States). 5 Dec 1951. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. (SR/H–458). Order Number DE93011153. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report details a trip to Monsanto to discuss a slug contamination, slug jacket removal, and the rectilinear manipulator.

23565 (DPW–4148) **Recovery of D_2O from fuel tubes.** Pohl, H.A. Du Pont de Nemours (E.I.) and Co., Wilmington, DE (United States). 19 Dec 1951. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. (SR/H–445). Order Number DE93011139. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This memorandum describes a number of proposals for removing adhering D_2O from fuel tubes as they are unloaded. It is estimated that some $5000–10,000 worth of D_2O clings to the Q-tubes as they are unloaded.

23566 (DPW–4295) **[Travel to New York to attend a meeting which was held at the New York Operations Office for the discussion of thorium]: Trip report, November 6, 1951.** Montenyohl, V.I.; Hayes, E.E. Du Pont de Nemours (E.I.) and Co., Wilmington, DE (United States). Explosives Dept. 3 Dec 1951. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. (SR/H–460). Order Number DE93011155. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report discusses travel to New YORK to attend a meeting which was held at the New York Operations Office for the discussion of thorium.

23567 (DPW–4489) **Reactor fuel elements.** Neill, J.S. Du Pont de Nemours (E.I.) and Co., Wilmington, DE (United States). 29 Jan 1952. 22p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. (SR/H–464). Order Number DE93011159. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Clumping of the fuel rods in a Q-foil results in a peripheral variation in the surface heat flux emanating from the rod. By placing the fuel rods exccentric in the tubes and inward toward the center of the Q-foil a more uniform surface temperature will be realized. Accordingly, an eccentricity of 25 mils for the 1 in. rod in the Q-foil has been recommended by W. A. Selke. Because of the necessary clearances between the rod and the rib circle of 33 mils, as given by G. E. Boudreau, the actual eccentricity will deviate from this nominal eccentricity of 25 mils. The purpose of this memorandum is to show the variation of the power loss with the actual eccentricity and to point out what the clearance costs in power.

23568 (DPW–4836) **Savannah River Plant estimated power costs, fiscal year 1953–1956.** Kaiser, A.H. Du Pont de Nemours (E.I.) and Co., Wilmington, DE (United States). 12 Mar 1952. 38p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. (SR/H–507). Order Number DE93011204. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report provides estimated power costs for fiscal years 1953, 1954, 1955, and 1956 for the Savannah River Plant as requested by the AED Control Division. An explanation of the assumptions used preparing the estimated power costs and a description of power facilities involved are also given.

23569 (DPW–4851) **NYX construction progress.** Elliott, J.F. Du Pont de Nemours (E.I.) and Co., Wilmington, DE (United States). 13 Mar 1952. 2p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. (SR/H–506). Order Number DE93011203. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report provides a progress report of the NYX construction progress. Details are presented on the problems in line boring of the plenum and top shield.

23570 (DPW–4906) **New fuel element development report of meeting held March 18, 1952.** Huntoon, R.T. Du Pont de Nemours (E.I.) and Co., Wilmington, DE (United States). 19 Mar 1952. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. (SR/H–503). Order Number DE93011200. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The principle interest of this meeting was the discussion of a tentative program for corrosion testing to be presented to ANL. The requirements of the tests were outlined and specifications for specimens were detailed. Fabrication and sheathing of the elements was briefly discussed and it was agreed that the first experimental elements to be produced will be alpha rolled uranium or uranium-zirconiums alloys sheathed with aluminum applied by cold drawing.

23571 (DPW–4908) **Background flux in Pu producer.** Ring, H.F.; Crandall, J.L. Du Pont de Nemours (E.I.) and Co., Wilmington, DE (United States). 19 Mar 1952. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. (SR/H–504). Order Number DE93011201. Source: OSTI; NTIS (US Sales Only); GPO Dep.

With all rods fully inserted in the 61 septifoil positions of the Pu producer, the file is subcritical by about 8% in k; however, because of spontaneous fissions in the metal, there persists in the pile a measurable, albeit small, background flux. In this memorandum the static background flux, for various subcritical control rod configurations, has been calculated.

23572 (DUN–850-1) **Manufacturing Section semiannual summary report, period ending June 30, 1966.** DeNeal, D.L. Douglas United Nuclear, Inc., Richland, WA (United States). 1 Sep 1966. 20p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93012051. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This is the second semiannual issue of reactor and power operations data for the Hanford Production Reactors. Summary data from the first issue (1) are repeated for comparison. Experience during each succeeding six months period will be added to these data in later reports until two full years of operating experience are shown. For comparison purposes, the two years of experience will then continue to be shown by dropping and adding a six months period with each semiannual issue. This report is for the period ending June 30, 1966.

23573 (DUN–850-2) **Manufacturing Section semiannual summary report, period ending December 31, 1966.** DeNeal, D.L. Douglas United Nuclear, Inc., Richland, WA (United States).

31 Jan 1967. 21p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93012052. Source: OSTI; NTIS (US Sales Only); GPO Dep.

In this third semiannual issue, the reactor and power data from the Hanford Production Reactors are shown for the six-month period July through December, 1966, together with the two preceding six-month periods. Experience during the succeeding six-month period will be added in the next semiannual issue. For comparison purposes, the two years of experience will then continue to be shown by dropping and adding a six-month period with each semiannual issue.

23574 (DUN–850-3) **Manufacturing Section semiannual summary report, period ending June 30, 1967.** DeNeal, D.L. Douglas United Nuclear, Inc., Richland, WA (United States). 15 Sep 1967. 21p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93012053. Source: OSTI; NTIS (US Sales Only); GPO Dep.

In this fourth semiannual issue, the reactor and power data from the Hanford Production Reactors are shown for the six-month period January through June, 1967, together with data for the three preceding six-month periods. For comparison purposes, the two years of experience will continue to be shown by dropping and adding a six- month period with each semiannual issue.

23575 (DUN–4977) **Water treatment test facility studies, July 1964–July 1967.** Geier, R.G. Douglas United Nuclear, Inc., Richland, WA (United States). 5 Nov 1968. 63p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93012157. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The water treatment test facility consists of eight process tubes in KE. Reactor which can be supplied with coolant independently of the normal reactor coolant supply. Raw water, service water, process water, deionized water, or water specially treated in a water treatment pilot plant can be used as coolant. The facility, has been in use for many-years to study the effects of coolant modifications on corrosion. More recently, it has also been a test facility in the research and development program directed toward finding means to reduce the quantity of radioactivity data. This document summarizes the tests carried out during the period from July 1964 through July 1967. Effluent radioactivity data are presented as well as the visual characteristics and the weight loss data of the fuel elements irradiated during the tests. An in-depth analysis of the corrosion information has not been attempted, but where significant changes in corrosion were apparent, they have been noted.

23576 (DUN–5566-3) **Single pass reactors: Operations Division semiannual summary report period ending June 30, 1970.** Prudich, T. Douglas United Nuclear, Inc., Richland, WA (United States). 3 Sep 1970. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93012058. Source: OSTI; NTIS (US Sales Only); GPO Dep.

In this semiannual issue the single pass reactor and water plant data are shown for the six-month period January through June, 1970, together with data for the three preceding six-month periods.

23577 (DUN–5566-4) **Single pass reactors: Operations Division semiannual summary report period ending December 31, 1970.** Prudich, T. Douglas United Nuclear, Inc., Richland, WA (United States). 20 Jan 1971. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93012059. Source: OSTI; NTIS (US Sales Only); GPO Dep.

In this semiannual issue the single pass reactor and water plant data are shown for the six-month period July through December, 1970, together with data for the three preceding six-month periods.

23578 (DUN–6463) **Dichromate evaluation.** Carlson, P.A. Douglas United Nuclear, Inc., Richland, WA (United States). 4 Nov 1969. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93012061. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Fuel failure statistics coupled with preliminary results from the half-plant dichromate test recently completed at KW Reactor show that process water with 0.5 ppm dichromate is significantly more corrosive than process water containing 1.0 ppm dichromate with respect to localized aluminum cladding corrosion. This report provides interim water chemistry specifications subject to revision when the test data analysis is complete.

23579 (DUN–6476) **Memorandum of process standards 9-16M sodium dichromate and pH requirements, K Reactors.** Reid, R.W. Douglas United Nuclear, Inc., Richland, WA (United States). 18 Nov 1969. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93012062. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The purpose of this memorandum is to provide interim limits for a lower sodium dichromate feed to reduce water treatment costs. The interim limits are a function of exit water temperature and pH. The process standards will be revised when current studies on the effects of dichromate reduction are completed.

23580 (DUN–7166) **K Reactor dichromate test results.** Carlson, P.A. Douglas United Nuclear, Inc., Richland, WA (United States). 29 Jul 1970. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93012063. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This memorandum provides a discussion of the K Reactor dichromate test results. Recommendations as to sodium dichromate concentration control are provided. (FL)

23581 (DUN–7253) **Half-plant low dichromate evaluation at KW Reactor: Production Test-176: Final report.** Larrick, A.P. Douglas United Nuclear, Inc., Richland, WA (United States). 30 Sep 1970. 55p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93012160. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This final report details production test-176, the primary purpose of which was to provide a quantitative comparison of fuel element 8001 aluminum alloy cladding corrosion in cooling water containing 0.5 and 1.0 ppm sodium dichromate inhibitor. Secondary purposes were to provide information on cladding corrosion as a function of temperature and as a function of time at both inhibitor concentrations. The primary purpose was well fulfilled: Equations were developed to describe and predict fuel element weight losses at both dichromate concentrations and the effect of dichromate concentration on localized corrosion was clearly established. Little effect of dichromate concentration on localized corrosion was observed when fuel cladding temperatures were below 115–120 C but above these temperatures the localized corrosion definitely was more severe in coolant containing 0.5 ppm inhibitor. The bottom rows of fuel element supports rapidly corroded away at the higher temperatures which caused a further increase in local temperatures due to flow imbalances and this in turn accelerated the localized corrosion. Because the higher dichromate concentration reduced the amount of support corrosion, 1.0 ppm dichromate should be employed to control localized corrosion whenever cladding temperatures are expected to be above 120 C for long periods of time. These tests indicated that the corrosion occurring at exposures of 66 operating days, and with clad temperatures of 120 C or above, would not seriously limit fuel integrity at 0.5 ppm inhibitor but that for exposures of 105 operating days extensive pitting corrosion would be expected.

23582 (EGG-NRE–10735) **Broad Application Test Reactor cost reduction study.** Sekot, J.P. (USDOE Idaho Field Office, Idaho Falls, ID (United States)); Amidei, W.; Kologi, A.L.; Lopez, D.A.; McDaniel, J.H.; Mousseau, D.R.; Motloch, C.G.; Pierce, R.L.; Rogers, N.K.; Ryskamp, J.M.; Sherick, D.M.; Sorman, K.L.; Stanley, V.R.; Werner, J.EG and G Idaho, Inc., Idaho Falls, ID (United States). Mar 1993. 31p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-76ID01570. Order Number DE93013741. Source: OSTI; NTIS; INIS; GPO Dep.

A Broad Application Test Reactor (BATR) is needed to provide nuclear testing capacity and capability for future testing needs. The BATR concept is expected to consider a broad range of test applications. The present day costs of design and construction of new nuclear facilities demands that methods, processes, and requirements be critically reviewed and improved if these facilities are to be affordable in the future. The cost of major new projects in this

country has been escalating faster than the rate of inflation. For example, the Advanced Test Reactor (ATR), a reactor built at the Idaho National Engineering Laboratory (INEL) in the early sixties, cost about $38M in 1960 dollars. Estimates to build that same reactor today range as high as $1B. Although somewhat different in mission, but in many respects comparable to theATR in function, size, and complexity, the Advanced Neutron Source (ANS) proposed by the Oak Ridge National Laboratory (ORNL), is currently estimated to cost about $2B for design and construction. This report presents cost concerns, cost reduction ideas, and recommendations that were identified and developed by the Cost Reduction Study Team for consideration by the BATR Design Team.

23583 (ERA-NRE–93-022) **Measured thermal and fast neutron fluence rates, ATR Cycle 99-B, January 24–March 14, 1993.** Murray, R.K.; Rogers, J.W. EG and G Idaho, Inc., Idaho Falls, ID (United States). Apr 1993. 75p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-76ID01570. Order Number DE93013682. Source: OSTI; NTIS; INIS; GPO Dep.

This report contains the thermal (2200 m/s) and fast (E>1MeV) neutron fluence rate data for ATR Cycle 99-B which were measured by the Radiation Measurements Laboratory (RML) as requested by the Power Reactor Programs (ATR Experiments) Radiation Measurements Work Order. This report contains fluence rate values corresponding to the particular elevations (relative to the 80 ft core elevation) where the measurements were taken. The data in this report consists of (1) a table of the ATR power history and distribution, (2) a hard copy listing of all thermal and fast neutron fluence rates, (3) plots of both the thermal and fast neutron fluence rates, and (4) a magnetic record (3.5 inch diskette) containing a listing of only the fast neutron fluence rates, their assigned elevations and proper header identification of all monitor positions contained herein. The fluence rates reported are for the average power levels given in the table of power history and distribution. All "H" holder monitor wires for this cycle are 54 inches long. All "SR" holder monitor wires for this cycle are 55 inches long. This length allows measurement of the full core region and makes the first count elevation 24.73 inches above core midplane. Due to the safety rod problems in the west lobe, "BR" holders were used in the W-1, 2, 3, and 4 positions. All "BR" holder monitor wires for this cycle are 56.25 inches long. The distance from the end of the wires to the first count position was 4.25 inches for all wires counted from this cycle. The results from the measurements in the W-1, 2, 3, 4 monitor positions indicate that the safety rod followers were rotated to a different azimuthal orientation relative to the normal orientation. The results indicate that the rotation was counterclockwise from their normal orientation.

23584 (FEI–2114) **Realization of the technique for evaluation of integral experiments under the BFS bench conditions.** Bednyakov, S.M. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk (Russian Federation). Fiziko-Ehnergeticheskij Inst. 1990. [18p.] (In Russian). Order Number DE93626299. Source: OSTI; NTIS (US Sales Only); INIS.

The HEEPC universal calculational complex providing adequate conditions for calculations and BFS measurements has been created. The HEEPC complex allows to analyse central reactivity worths, integral fission and capture cross-sections, multiplication factors of infinite and finite critical media measurements. Adequate conditions of calculational and experimental data are received by correct evaluation of cell structure heterogeneity, experimental samples self-shielding and adjoint flux resonance structure. 10 refs.

23585 (HAN–54065) **100 and 300 Areas monthly report, December 1954.** Paulovich, K.F.; Scott, G.F. USAEC Hanford Operations Office, Richland, WA (United States). 4 Jan 1955. 312p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93012060. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This is a compilation of the monthly reports for the 100 and 300 Areas at HAPO for 1954. Reactor fuels, reactor technology, and reactor operation are discussed.

23586 (HAN–58378-Del.) **Reactor Operation Branch monthly reports, January–December 1955.** Paulovich, K.F. US-AEC Hanford Operations Office, Richland, WA (United States); Battelle Pacific Northwest Lab., Richland, WA (United States). 1 Sep 1955. 154p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93012065. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document provides the monthly reports for the Reactor Operation Branch for the months of January through December 1955.

23587 (HW–7-2172) **Spectroscopic analysis of pile gas.** Dineen, F.H. Hanford Atomic Products Operation, Richland, WA (United States). 10 Aug 1945. 1p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93012066. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This memorandum provides results of spectroscopic analysis of pile gas which were completed on August 4, 1945.

23588 (HW–37945) **Information on irradiation facilities and supporting laboratories at HAPO.** Clark, W.H. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 8 Jun 1955. 28p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93010545. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document has been prepared in response to a request from the Atomic Energy Commission, HOO. It is a compilation of the major experimental irradiation spaces and supporting facilities at Hanford. The information is of necessity sketchy but considered adequate for survey,purposes. Organizations planning single experiments or extensive irradiation.programs are advised to seek guidance through AEC-HOO. The legend is presented largely for the benefit of those totally unfamiliar with the Hanford reactors.

23589 (HW–44097) **Reactor gas loss analysis.** Dow, T.D. Hanford Atomic Products Operation, Richland, WA (United States). 12 Jul 1956. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93012067. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Reactor gas costs have increased substantially each year since 1952 when the total cost was $108,000. In 1953, 1954, and 1955 the gross annual cost of reactor gas was $126,000, $348,000 and $606,000 respectively and are reported in Figure 1. These continued increases in reactor gas costs indicate the need for an analysis of gas usage and formulation of a program to reduce gas consumption. To provide basic information for such a program, a critical review has been made of the reaction gas system and gas consumption figures for the past four years.

23590 (HW–55819) **Graphite radiation damage as a reactor operational problem.** Curtiss, D.H. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 14 Apr 1958. 28p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-571202–1: US-UK graphite conference, London (United Kingdom), 16-18 Dec 1957). Order Number DE93009990. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Radiation Damage to the graphite moderator has played an important role in the history of reactor operation at Hanford. The operational problems, potential and real, which result from dimensional instability, stored energy, and gasification, as well as the solutions to these problems are discussed. The key to the graphite problems is operating temperature and its control. At present, stack expansion remains in the fringe regions of the original reactors, which coupled with the contraction of the central region gives rise to curvature problems in the top portion of the reactors. Stored energy is not a safety hazard because the release spectrum is such that a spontaneous and self sustained release cannot occur. Oxidation of the graphite moderator is controlled by maintaining operating temperature of the stack such that no significant amount of oxidation occurs.

23591 (HW–55862) **Separan for water treatment.** Pitman, R.W.; Conley, W.R. Hanford Atomic Products Operation, Richland, WA (United States). 5 Jan 1956. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93012068. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Separan is a now water plant coagulant chemical which was submitted to the Process Sub-Section for evaluation in late 1954. Beaker tents were run which showed the material to be potentially valuable in modern water filter plants, but thorough evaluation was impossible because proper testing facilities were not available. Since August 1955, Process Sub-Section has operated an experimental filter plant which has shown promise as an evaluation tool. Consequently, as the facility appeared to be adequate for testing Separan, a trial run was made. The results have been so promising that an interim report was thought desirable. The results of our primary tests follow.

23592 (HW–72383) **Production Test IP-485-A – Fuel element film formation studies.** Geier, R.G. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 22 Jan 1962. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93012069. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The objectives of the test described in this report was to determine the inventory of radionuclides in the films on standard production reactor fuel elements and the corrosion of these fuel elements as a function of position in the reactor.

23593 (HW–77683) **Provisional specifications for the hot die sizing process.** Burgess, C.A.; Stinger, J.T.; Greager, O.H. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 20 May 1963. 59p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93010555. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Hot die sizing is one of three solid state diffusion bonding (SSDB) processes that has been proposed as an alternate manufacturing process for fabricating HAPO metallic uranium, aluminum-clad fuel elements. This document establishes the provisional process specifications for the assembly of fuel elements by the hot die sizing process. These specifications were developed for the CDB2N model fuel element (CSN equivalent AlSi model) and do not necessarily apply to any other model.

23594 (HW-SA–7377) **Technical bases for K Reactor dichromate and pH control.** Larrick, A.P. Douglas United Nuclear, Inc., Richland, WA (United States). 12 Nov 1970. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (DUN–7377). Order Number DE93012071. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This memorandum was written to provide additional technical basis for preparing Process Standards. Fuel surface-tube outlet temperature data is also provided. These data will help establish dichromate concentration and coolant pH based on the outlet coolant temperatures of the hottest reactor process tubes.

23595 (IAEA-TECDOC–690, pp. 159-168) **Relation between gasification rates and gas desorption behavior with metallic impurities of carbon and graphite materials for the HTTR.** Nomura, S. (Japan Atomic Energy Research Inst., Tokai, Ibaraki, (Japan). Dept. of Fuels and Materials Research); Fujii, K.; Shindo, M.; Imai, H. International Atomic Energy Agency, Vienna (Austria). Feb 1993. (CONF-9109266–: International Atomic Energy Agency (IAEA) specialists meeting on status of graphite development for gas-cooled reactors, Tokai (Japan), 9-12 Sep 1991). In *The status of graphite development for gas cooled reactors: Proceedings of a specialists' meeting held in Tokai, Japan, 9-12 September 1991.* [311p.] Order Number DE93625195. Source: OSTI; NTIS (US Sales Only); INIS.

Gasification rates of carbonaceous materials by water vapor and carbon dioxide were strongly dependent upon both the kind of metallic impurities and their concentrations present in the materials. Similar relations were also held for gas desorption behavior from the carbonaceous materials. Seventeen kinds of carbons and graphite were oxidized in helium flow containing 0.65% of water vapor and carbon dioxide in the temperature range from 800 to 1000 deg. C. The rates of reaction with carbon dioxide were relatively equal to those with water vapor. The gasification rates increased with the sum of contents of transition metal impurities Fe, Ti, V and Ni. Structural parameters of the carbonaceous materials, the degree of graphitization, the crystallite size Co and c-axis lattice strain of the graphite crystallite hardly affected and gasification rates. The compensation effect between the activation energies and the pre-exponential factors of the reaction was found to exist in both gasifications. This means that the gasification is governed by catalytic action of the metallic impurities. Isokinetic temperatures, at which all catalyst lose their activity, were 1230 deg. C for the reaction with water vapor and 1120 deg. C with carbon dioxide. Six kinds of carbonaceous materials and some metallic impurities doped natural graphite powder compacts were used for the gas desorption experiments. Gases evolved from the materials up to 1000 deg. C were CO_2, CO, H_2, CH_4 and physically adsorbed species, N_2, O_2 and H_2O. Total volume of the former group of gases evolved from the graphite materials was correlated to both; their ash contents and the gasification rates with water vapor at 1000 deg. C. The effect of metallic impurities Ca, Fe, Ni, Al and Si on the former gas species evolution behavior was also investigated. (author). 16 refs, 17 figs, 3 tabs.

23596 (JAERI-M–92-201) **Characteristics of the JRR-3M neutron guide tubes.** Suzuki, Masatoshi (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Tokai Research Establishment); Ichikawa, Hiroki; Kawabata, Yuji. Japan Atomic Energy Research Inst., Tokyo (Japan). Jan 1993. 22p. (In Japanese). Order Number DE93797509. Source: OSTI; NTIS; INIS.

Large scale neutron guide tubes have been installed in the upgraded JRR-3 (Japan Research Reactor No.3, JRR-3M). The total length of the guide tubes is 232m. The neutron fluxes and spectra were measured at the end of the neutron guide tubes. The neutron fluxes of thermal neutron guide tubes with characteristic wavelength of 2A are 1.2×10^8 n/cm^2 · s. The neutron fluxes of cold guide tubes are 1.4×10^8 n/cm^2 · s with characteristic wavelength of 4A and 2.0×10^8 n/cm^2 · s with 6A when the cold neutron source is operated. The neutron spectra measured by time-of-flight method agree well with their designed ones. (author).

23597 (JAERI-M–93-002) **Evaluation for material inspection of graphite inspection standard in High Temperature Engineering Test Reactor.** Iyoku, Tatsuo (Japan Atomic Energy Research Inst., Oarai, Ibaraki (Japan). Oarai Research Establishment); Takikawa, Noboru; Shiozawa, Shusaku; Sawa, Kazuhiro; Tsuji, Masanobu; Yamada, Kunitaka; Sugihara, Tetsuya. Japan Atomic Energy Research Inst., Tokyo (Japan). Jan 1993. 33p. (In Japanese). Order Number DE93797568. Source: OSTI; NTIS; INIS.

The graphite inspection standard for the High Temperature Engineering Test Reactor (HTTR) consists of material, nondestructive, dimensional and visual inspections. The inspection method and judgement criteria in the material inspection are nor detailed in some items, although some explanations are provided for the items especially necessary to be considered in the inspection. Therefore, inspection method and judgement criteria in the material inspection which contains material grade, impurity and mechanical strength inspections, are fully evaluated on the basis of the feature of these materials. Material inspection method and judgement criteria for HTTR graphite and carbon are evaluated in consideration of the research data and manufacturing experiences. As a result, inspection method and judgement criteria can be established, which are to be applied to the graphite and carbon internal acceptance tests of HTTR. (author).

23598 (LIYaF–1563) **Advanced irradiation of indicative vessel samples in the PIK reactor core.** Vasil'ev, G.Ya.; Egodurov, S.D.; Konoplev, K.A.; Pikulik, R.G.; Potapov, I.A.; Smol'skij, S.L.; Solovej, V.L.; Chmshkyan, D.V. AN SSSR, Leningrad (Russian Federation). Inst. Yadernoj Fiziki. Dec 1989. [11p.] (In Russian). Order Number DE93626300. Source: OSTI; NTIS (US Sales Only); INIS.

Possibility of advanced irradiation of indicative vessel samples by fast neutron fluence in the PIK reactor core has been investigated. Fast neutron flux density Φ (neutron energy being above 1.2 MeV) in the core and in the model ampoules with indicative samples has been measured in the critical assambly called Physical model of the PIK reactor and calculated by Monte-Carlo TAU code. The value of Φ in indicative vessel samples irradiated in the middle part of the core is 1.7 ± 0.1 times greater than the value of Φ on the inner surface of the vessel. 5 refs.; 2 figs.; 1 tab.

23599 (ORNL/FTR–4200) **Travel to Japan to participate in a discussion session at the fourth international symposium on advanced nuclear research: Foreign trip report, January 21, 1992–February 8, 1992.** Bloom, E.E. Oak Ridge National Lab., TN (United States). 25 Feb 1992. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93011029. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The traveler attended, presented an invited paper, and participated in a discussion session at the Fourth International Symposium on Advanced Nuclear Energy Research Roles and Direction of Materials Science in Nuclear Technology, which was held on February 5–7, 1992, in Mito, Ibaraki, Japan. This report summarizes the technical content and the traveler's impressions of the symposium. Prior to the travel to Japan, the traveler participated in a meeting of the Steering Committee for the US/Japan Collaborative Program for Testing Structural Materials with Mixed Spectrum Reactors (January 22, 1992) and Joint Japan Atomic Energy Research Institute (JAERI)/Monbusho/US Department of Energy (DOE) Workshop on Mid-Program Review of Technical Progress (January 24–25, 1992) in Honolulu, Hawaii. Brief summaries of these two meetings are also included in this trip report.

23600 (ORNL/FTR–4302) **[Travel to France and New Orleans to discuss the analysis and testing work at the New Production Reactor-Heavy Water Reactor]: Foreign trip report, June 10–25, 1992.** Poole, A.B. Oak Ridge National Lab., TN (United States). 26 Jun 1992. 29p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93011070. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The traveler presented a paper on "Thermal Stress Models for Stratified Flows and Fatigue Calculation Methods for Time-Varying Boundary Conditions such as Thermal Striping Gradients Together with 60-Year Lifetime Analysis and Full-Scale Flawed Pipe Fracture Testing" at the Symposium in Paris. This paper discussed the analysis and testing work completed at the Oak Ridge National Laboratory (ORNL) for the Department of Energy's (DOE's) New Production Reactor-Heavy Water Reactor (NPR-HWR) Program. In particular, computer analysis studies of fatigue crack growth in stainless steel type 316LN material over a projected lifetime of 60 years were presented. Also, the Pipe Impact Testing Facility (PITF) at ORNL was reviewed and some general test results discussed. There was an international exchange of new testing methodologies (fatigue and fracture tests) with specific emphasis on "Automation" through the use of computers looped directly in the collection of data and programmed to facilitate the testing process. The traveler also attended the 1992 ASME PVP Conference in New Orleans, Louisiana. At the PVP Conference, a paper was presented on "Pipe Break Testing of Primary Loop Piping Similar to DOE's NPR-HWR". In addition to the paper, a video presentation was made showing the test facility and some actual testing.

23601 (SR/H–523) **Power Department.** Hanford Engineer Works, Richland, WA (United States). [1946]. 189p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. Order Number DE93012363. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The Power Department is responsible for the operation of all steam and water facilities in the five production areas, as well as in the 300 Area and Richland. In the 100 Areas, this water responsibility extends into the Valve Pits of the Pile Buildings, and in the 200 Areas all air compressing, air conditioning, and ventilating facilities in the process buildings are operated by the Power Department. Richland resonsibilities include the sewage disposal plant. This memorandum reviews the functions and organization of the Power Department from its inception to July 1, 1945.

23602 (SR/H–536) **[Hanford Department Histories]: Instrument Department.** Plant Histories. Hanford Engineer Works, Richland, WA (United States). [1946]. 124p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. Order Number DE93013022. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The complexity, diversity, and unique character of instrumentation at Hanford combined to necessitate the inclusion of a separate Instrument Department in the plant organization. Considerable instrument fabrication work has been involved, in addition to the unusual maintenance volume attending such extensive use of instruments. The Department also has been responsible for instrument development since the Technical Department discontinued this work in March 1945. This memorandum reviews the functions and organization of the Instrument Department from its inception to July 1, 1945. Similar reviews of the Department's activities are being presented in separate memoranda.

23603 (SR/H–537) **[Hanford Department Histories]: Maintenance Department.** Plant Histories. Hoenie, P.A.; McMahon, J.S.; Eshelman, R.L.; Wangelin, R.S.; Dorsey, G.W. Jr.; Heffner, J.M.; Dean, E.O.; Smithson, J.H. Hanford Engineer Works, Richland, WA (United States). [1946]. 208p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. Order Number DE93013023. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The Maintenance Department is responsible for all maintenance and new work in connection with buildings, facilities and equipment in all six plant areas and Richland, with the following exceptions: (a) Electrical equipment such as motors, transformers, lines, etc. is a responsibility of the Electrical Department.(b) All maintenance and new work in connection with instruments is a function of the Instrument Department.(c) Automotive equipment, railroad equipment, tracks and roads are maintained by the Transportation Department.The Department's responsibility for nev work usually includes the designing involved, and a group of engineers and draftsmen are assigned to this phase of the work. Another Departmental function is to conduct methods studies for all departments, as required. This memorandum reviews the functions and rganization of the Maintenance Department from its inception to July 1, 1945.

23604 (SR/H–548) **[The Hanford story, Chapters 9–11].** [Plant Histories]. Du Pont de Nemours (E.I.) and Co., Aiken, SC (United States). Savannah River Plant. [1943]. 239p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. Order Number DE93013449. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document provides Chapters 9, 10, and 11 of The Hanford Story. These chapters discuss Process Support, Materials Procurement and Processing, and Security. (FI)

23605 (WHC-EP–0619-Vol.2) **Risk management study for the retired Hanford Site facilities: Volume 2, Risk evaluation work procedure for the retired Hanford Site facilities.** Coles, G.A.; Shultz, M.V.; Taylor, W.E. Westinghouse Hanford Co., Richland, WA (United States). Apr 1993. 47p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE93013004. Source: OSTI; NTIS; INIS; GPO Dep.

Risk from retired surplus facilities has always been assumed to be low at the Hanford Site as the facilities are inactive and have few potentials for causing an offsite hazardous material release. However,the fatal accident that occurred in the spring of 1992 in which an employee fell through a deteriorated roof at the 105-F Reactor Building has raised the possibility that retired facilities represent a greater risk than was originally assumed. Therefore, Westinghouse Hanford Company and the US Department of Energy management have determined that facility risk management strategies and programmatic plans should be reevaluated to assure risks are identified and appropriate corrective action plans are developed. To evaluate risk management strategies, accurate risk information about the current and projected condition of the facilities must be developed. This work procedure has been created to address the development of accurate and timely risk information. By using the evaluation results in this procedure, it will be possible to create a prioritized baseline for managing facility risk until all retired surplus facilities are demolished.

23606 (WSRC-MS–92-167-Del.Ver.) **Enhancement of the source term algorithm for emergency response at the Savannah River Site.** Simpkins, A.A.; O'Kula, K.R.; Taylor, R.P.; Kearnaghan, G.P. Westinghouse Savannah River Co., Aiken, SC (United States). [1992]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. (CONF-930402–5: 4. topical meeting on emergency preparedness and

response, Long Island, NY (United States), 25-29 Apr 1993). Order Number DE93012845. Source: OSTI; NTIS; INIS; GPO Dep.

The purpose of this work is to use the results of the Savannah River Site K-Reactor Probabilistic Safety Assessment to determine the accident sequences and source terms for beyond design basis accidents. Additionally, the methodology necessary to allow the Reactor Accident Program to incorporate this information is to be discussed.

23607 (WSRC-MS–92-224) **Screening criteria for design basis events.** Paddleford, D.F.; Wooten, L.A. Westinghouse Savannah River Co., Aiken, SC (United States). [1992]. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. (CONF-930116–42: Probabilistic safety assessment international topical meeting (PSA 93), Clearwater Beach, FL (United States), 27-29 Jan 1993). Order Number DE93009875. Source: OSTI; NTIS; INIS; GPO Dep.

A risk based screening criteria was developed to assist in determining whether issues raised during K-reactor restart safety analyses needed to be part of the design basis, and if so, to guide the degree of conservatism in the analysis. This paper describes the development of this criterias existing precedents, and its implementation guidelines and restrictions.

23608 (WSRC-MS–92-362) **Flow regime mapping of vertical two-phase downflow in a ribbed annulus.** Kielpinski, A.L. Westinghouse Savannah River Co., Aiken, SC (United States). [1992]. 35p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. (CONF-930830–1: National conference and exposition on heat transfer, Atlanta, GA (United States), 8-11 Aug 1993). Order Number DE93004879. Source: OSTI; NTIS; INIS; GPO Dep.

Two-phase flow regimes have been mapped for vertical, cocurrent downflow in a narrow annulus which is partially segmented by the presence of longitudinal ribs. This geometry and flow condition has application to the analysis of a Large-Break Loss of Coolant Accident (LB-LOCA) in the production K-Reactor at the Savannah River Site (SRS). The ribbed annular geometry, particularly the presence of non-sealing ribs, gives rise to some unique phenomenological features. The flow behavior is influenced by the partial segmentation of the annulus into four quadrants or subchannels. A random element is induced by the natural bowing of the slender tubes; the width of the azimuthal flow path between two subchannels at a given axial location is indeterminate, and can take on any value between zero and the maximum clearance of 7.6×10^{-4} m. When the rib gap is zero at a given location, it is at a maximum 180P away at the same axial location. The range of rib gaps is spanned in a single test section, as it would be also in a reactor assembly. As a result of these effects, flow regime maps obtained by other researchers for downflow in annuli are not accurate for defining flow regimes in a ribbed annulus. Flow regime transitions similar to those noted by, e.g., Bamea, were observed; the locations of these transitions were displaced with respect to the transition equations derived by Bamea. Experimental bubble rise velocity measurements were also obtained in the same test section. The bubble rise velocities were much higher than expected from the theory developed for slug bubbles in tubes, unribbed annuli, and rectangular channels. An elliptical-cap bubble rises faster than a slug bubble of the same area. Large, slug-shaped bubbles injected into the test section were observed to reduce in size as they rose, due to interaction with a longitudinal rib. They thereby adopted a shape more like an elliptical-cap bubble, hence rising faster than the original slug bubble.

23609 (WSRC-MS–92-388) **Flow instability and flow reversal in heated annular multichannels with initial downward flow.** Guerrero, H.N.; Hart, C.M. Westinghouse Savannah River Co., Aiken, SC (United States). [1992]. 28p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. (CONF-930830–2: National conference and exposition on heat transfer, Atlanta, GA (United States), 8-11 Aug 1993). Order Number DE93006164. Source: OSTI; NTIS; GPO Dep.

Experimental and theoretical results are presented regarding the stability of initial downward flow of single phase water in parallel annular channels of the Savannah River Site (SRS) fuel assembly. The test was performed on an electrically heated prototypic mockup of a Mark-22 fuel assembly. The test conditions consisted of mass fluxes, from 98–294 kg/m^2-sec, and inlet water temperatures of 25°C and 40°C. With increased power to the heaters, flow instability was detected, characterized by flow fluctuations and flow redistribution among subchannels of the outer flow channel. With increased power, a condition was observed indicating local subchannel flow reversals where certain subchannel fluid temperatures were high at the inlet and low at the exit. With additional power increased, a critical heat flux condition was observed indicating local subchannel flow reversals where certain subchannel fluid temperatures were high at the inlet and low at the exit. With additional power increases, a critical heat flux condition was reached in the outer channel.

23610 (WSRC-MS–92-390) **Two-phase interfacial area and flow regime modeling in FLOWTRAN-TF code.** Smith, F.G. III; Lee, S.Y.; Flach, G.P.; Hamm, L.L. Westinghouse Savannah River Co., Aiken, SC (United States). [1992]. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. (CONF-930830–12: National conference and exposition on heat transfer, Atlanta, GA (United States), 8-11 Aug 1993). Order Number DE93009874. Source: OSTI; NTIS; INIS; GPO Dep.

FLOWTRAN-TF is a new two-component, two-phase thermal-hydraulics code to capture the detailed assembly behavior associated with loss-of-coolant accident analyses in multichannel assemblies of the SRS reactors. The local interfacial area of the two-phase mixture is computed by summing the interfacial areas contributed by each of three flow regimes. For smooth flow regime transitions, the code uses an interpolation technique in terms of component void fraction for each basic flow regime.

23611 (WSRC-MS–92-441) **Reactor cooling water expansion joint bellows: The role of the seam weld in fatigue crack development.** West, S.L.; Nelson, D.Z.; Louthan, M.R. Jr. Westinghouse Savannah River Co., Aiken, SC (United States). [1992]. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. (CONF-930850–1: 25. annual meeting of the International Metallographic Society (IMS), Denver, CO (United States), 2-5 Aug 1993). Order Number DE93004298. Source: OSTI; NTIS; INIS; GPO Dep.

The secondary cooling water system pressure boundary of Savannah River Site reactors includes expansion joints utilizing a thin-wall bellows. While successfully used for over thirty years, an occasional replacement has been required because of the development of small, circumferential fatigue cracks in a bellows convolute. One such crack was recently shown to have initiated from a weld heat-affected zone liquation microcrack. The crack, initially open to the outer surface of the rolled and seam welded cylindrical bellows section, was closed when cold forming of the convolutes placed the outer surface in residual compression. However, the bellows was placed in tension when installed, and the tensile stresses reopened the microcrack. This five to eight grain diameter microcrack was extended by ductile fatigue processes. Initial extension was by relatively rapid propagation through the large-grained weld metal, followed by slower extension through the fine-grained base metal. A significant through-wall crack was not developed until the crack extended into the base metal on both sides of the weld. Leakage of cooling water was subsequently detected and the bellows removed and a replacement installed.

23612 (WSRC-MS–92-519) **SRS supplemental safety system injection (gas pressurizer) test.** Howarth, W.L.; Dimenna, R.A. Westinghouse Savannah River Co., Aiken, SC (United States). [1992]. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. (CONF-930778–1: 1993 RELAP5 international users meeting, Boston, MA (United States), 6-9 Jul 1993). Order Number DE93012820. Source: OSTI; NTIS; INIS; GPO Dep.

An evaluation and validation of an existing version of the RELAP5 thermal hydraulics computer code was undertaken for the purpose of certification for use in the new production reactor - heavy water reactor (NPR-HWR) program. This version of the code was RELAP5/MOD3 Version 5q, designated for the purposes of the NPR-HWR program as RELAP5/NPR Version 0. As part of the evaluation and assessment, test data from theSRS Supplemental Safety System Injection (Gas Pressurizer) was used to verify and

assess the ability of RELAP5/NPR Version 0 to perform thermal-hydraulic model analysis using the test data. Specifically, the assessment determines RELAP5/NPR Version 0 capability in modeling sudden depressurization phenomena. Two RELAP5/NPR Version 0 components (pipe and accumulator) were used to compare calculated pressure and temperature against test data. The code deficiencies are a temperature clamp in the accumulator component prevents the gas temperature from going below −9°F, and RELAP5 accumulator and pipe components wall-to-fluid heat transfer correlation and interfacial vapor heat transfer correlation need substantial improvement. Only the code pipe component calculated pressures and temperatures within the specified 10 percent accuracy.

23613 (WSRC-RP–92-1099) **Unseated septifoil non-detection probability.** Topp, S.V. Westinghouse Savannah River Co., Aiken, SC (United States). Sep 1992. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE93014757. Source: OSTI; NTIS; INIS; GPO Dep.

The frequency that the Savannah River K-Reactor would proceed beyond hydraulic startup with a septifoil not properly seated is estimated in this report. It summarizes previous work on this subject, incorporates concerns about the utility of individual septifoil pressure measurements, and discusses two proposed techniques that could lower the non-detection probability to the point that this issue could be beyond Design Basis consideration.

23614 (WSRC-TR–92-12) **Structural integrity analysis of process water system Bingham pumps: Task Number: 91-086-1.** Gupta, N.K. Westinghouse Savannah River Co., Aiken, SC (United States). Oct 1992. 24p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE93013687. Source: OSTI; NTIS; GPO Dep.

Bingham pumps comprise part of the pressure boundary of the Process Water System (PWS). Monitoring the pump casing through in-service inspection is important to demonstrate the structural integrity throughout service. An acceptance criteria methodology with technical bases is provided to disposition flaws detected during examination of the pump casing. The methodology ensures that the defined structural or safety margins against failure are maintained throughout pump service in full consideration of service-induced degradation. Acceptance criteria, defining the acceptable flaw (length and depth) configurations for the pump casing, are established through structural analyses of the casing and flaw stability analyses of postulated flaws. Three-dimensional shell element model of the complex-shaped casing is constructed and detailed finite element stress analyses are performed at normal and off-normal loading conditions. Safety factors are applied to the resultant stresses and flaws are postulated at the most highly stressed regions of the pump casing. Postulated throughwall flaws in simplified casing configurations are analyzed with linear elastic and limit load methods with conservative application of the stress results. The most limiting results from the flaw stability analyses define The acceptable flaw length of 3.5 inches for the casing. The pump suction cover was separately analyzed to study the bolt failure concerns. Analyses were performed considering all bolts intact, all bolts cracked (25% deep through minor diameter), and up to 8 bolts inactive. It is found that as many as 4 bolts could be completely broken without adversely impacting the pressure boundary of the pumps at the design and operating conditions. Therefore, the current practice of volumetric and surface examination of the suction cover bolts is sufficient for the continued safe operation of the pumps.

23615 (WSRC-TR–92-044) **Verification, validation, and benchmarking report for TRIMHX: A three dimensional hexagonal transient diffusion theory code.** Le, T.T. Westinghouse Savannah River Co., Aiken, SC (United States). Mar 1992. 51p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE93014756. Source: OSTI; NTIS; INIS; GPO Dep.

TRIMHX is a fundamental Reactor Analysis tool in use at the Savannah River Site (SRS) and is an integral part of the Generalized Reactor Analysis Subsystem (GRASS). TRIMHX solves the time dependent multigroup neutron diffusion equation in two and three dimensional hexagonal geometry by standard and coarse mesh finite difference methods. The TRIMHX implementation assumes the solution to this equation can be discretized in space, energy, and time. These are industry accepted approaches which can be found in many nuclear engineering books. This report concerns the verification and validation of TRIMHX, a transient two and three dimensional hex-z diffusion theory code. The validation was performed to determine the accuracy of the code, and the verification was performed to determine if the code was correctly using the correct theory and that all the subroutines function as required. For TRIMHX, the validation requirement was satisfied by comparing the results of the code with experiments and benchmarking the code against other standard or validated code results. The verification requirement for TRIMHX was performed indirectly since it is impossible and not necessary to reverify a large code like TRIMHX line by line. The extensive operations history of TRIMHX in conjunction with the comparisons against many numerical experiments (exact solutions) and other diffusion theory codes is sufficient to establish that the code is functioning as intended and therefore it is verified. This report summarizes four sets of experiments performed in 1974, 1977, and 1988, two DIF3D/TRIMHX comparison problems performed in 1991, a DIF3D/FX2-TH/TRIMHX comparison problem produced for this report, and the comparison of TRIMHX/GRIMHX initial static calculations. The results of these experiments show that TRIMHX was correctly implemented and is ready to submit into SCMS production mode.

23616 (WSRC-TR–92-532) **FLOWTRAN-TF software design.** Aleman, S.E.; Flach, G.P.; Hamm, L.L.; Lee, S.Y.; Smith, F.G. III. Westinghouse Savannah River Co., Aiken, SC (United States). Feb 1993. 597p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE93012824. Source: OSTI; NTIS; GPO Dep.

FLOWTRAN-TF was created to analyze an individual Mk22 fuel assembly during a large break Loss Of Coolant Accident (LOCA) scenario involving the Savannah River Site K-reactor after the initial few seconds of the transient. During the initial few seconds reactor cooling is limited by the static or Ledinegg flow instability phenomenon. The predecessor FLOWTRAN code was developed to analyze this portion of a LOCA. In the several seconds following the break, a significant fraction of the reactor coolant inventory leaks out the break, Emergency Cooling System (ECS) flow is initiated, and air enters the primary coolant circulation loops. Reactor fuel assemblies are cooled by a low flowrate air-water downflow. Existing commercial nuclear industry thermal-hydraulic codes were judged inadequate for detailed modeling of a Mk22 fuel assembly because the application involves a ribbed annular geometry, low pressure, downflow and an air-water mixture. FLOWTRAN-TF is a two-phase thermal-hydraulics code of similar technology to existing commercial codes such as RELAP and TRAC but customized for Savannah River Site applications. The main features and capabilities of FLOWTRAN-TF are detailed Mk22 fuel assembly ribbed annular geometry; conjugate heat transfer; detailed neutronic power distribution; three-dimensional heat conduction in Mk22 fuel and target tubes; two-dimensional coolant flow in channels (axial, azimuthal); single-phase and/or two-phase fluid (gas, liquid and/or gas-liquid); two-component (air, water); constitutive models applicable to low pressure air-water downflow in ribbed annular channels. The design of FLOWTRAN-TF is described in detail in this report which serves as the Software Design Report in accordance with Quality Assurance Procedure IV-4, Rev. 0 "Software Design and Implementation" in the 1Q34 manual.

23617 (WSRC-TR–93-002) **Wall thinning criteria for low temperature-low pressure piping: Task 91-030-1.** Mertz, G.E. Westinghouse Savannah River Co., Aiken, SC (United States). Jan 1993. 58p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. (SRT-MTS–92-1241). Order Number DE93013694. Source: OSTI; NTIS; GPO Dep.

This acceptance criteria is intended to prevent gross rupture or rapidly propagating failure during normal and abnormal operating conditions. Pitting may be present in the carbon steel piping. While the acceptance criteria have provisions to preclude gross rupture through a pitted region, they do not protect against throughwall pit growth and subsequent leakage. Potential leakage through a pit in

low pressure piping is less than the post-DBE design basis leakage. Both the uniform thinning and LTA criteria protect against leakage, since their potential for leakage is larger. The acceptance criteria protects against gross rupture due to general wall thinning, local wall thinning (LTA's), pitting, and fracture through weld defects. General wall thinning calculations are based on the restart criteria, SEP-24. LTA criteria for hoop stresses are based on ASME Code Case N-480 "Examination Requirements for Pipe Wall Thinning Due to Single Phase Erosion and Corrosion". The LTA criteria for axial stress is based on an effective average thickness concept, which prevents plastic collapse of a locally thinned pipe. Limits on pit density, based on an effective cross section concept, are used to prevent gross rupture through a group of pits. The CEGB R-6 failure assessment diagram is used in the fracture evaluation, along with postulated weld defects. This criteria is intended for low temperature, low pressure piping systems. Corrosion and/or weld defects increase the peak stresses during normal operation and may lead to a reduction in fatigue life. Piping systems subject to significant thermal or mechanical fatigue will require additional analysis which is beyond the scope of this document.

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Refer also to citation(s) 23148, 23149, 23363, 23455, 23472, 23491, 23503, 23516, 23517, 23544, 23546, 23605, 23606, 23610, 23611, 24871, 24911, 25401

23618 (ANL/NPR–91/2-Vol.1) **Shake table tests of long period isolation system for nuclear facilities at soft-soil sites: Volume 1: New Production Reactors Program.** Kelly, J.M. (California Univ., Berkeley, CA (United States). Earthquake Engineering Research Center). Argonne National Lab., IL (United States). Mar 1991. 131p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. Order Number DE93011655. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report describes the results of a test program of shake table studies for the purpose of assessing the safety of the base isolation design for the Heavy Water Reactor/New Production Reactor (HWR/NPR). The study was carried out on the 6 m x 6 m shake table at the Earthquake Simulator Laboratory of the Earthquake Engineering Research Center (EERC) of the University of California at Berkeley. For this test program, a number of site specific ground motion time histories were developed. These incorporated the effects of the soil profile, the site frequency, the degree of embedment of the structure and the anticipated soil-structure interaction of the isolated structure. The model used represented overall inertial properties of the structure at a scale factor of six. Two isolation systems were used, each based on multilayer natural rubber bearings. One system used a high damping rubber with similar properties to one widely used for civil structures in California. The other system used a newly developed high damping compound with a low shear modulus, which provides a frequency of about twenty-five percent lower than the first system. The test program thus allowed the assessment of long period isolation systems with long period ground motion and the degree to which the isolation system produced structural responses advantageous for equipment and piping design.

23619 (ANL/NPR–92/5) **Molten fuel fragmentation experiments: Stage 1: New Production Reactors Program.** Gabor, J.D.; Purviance, R.T.; Cassulo, J.C.; Spencer, B.W. Argonne National Lab., IL (United States). Sep 1991. 95p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. Order Number DE93011351. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report discusses a series of seven real-material experiments which has been completed examining the interaction between molten HWR-NPR core materials and water under postulated HWR-NPR core melt accident conditions. The work was conducted at essentially full scale, and depicts the stage of a postulated, protected accident when molten core materials relocate downward from a melting fuel assembly into the inlet region of the assembly and into an open, water-filled lower plenum below the assemblies. The objectives of the investigations were to provide a database on melt fragmentation, quenching, and debris characterization for THIRMAL code validation using HWR-NPR accident conditions and materials, and moreover, to explore the possibilities of a steam explosion as well as the extent of chemical reactions under these (untriggered) in-vessel melt-water interaction conditions.

23620 (ANL/NPR–92/15) **Transient analysis of dissolution of a reactor bottom head into a melt pool.** Tan, M.J. (Argonne National Lab., IL (United States)); Cho, D.H.; Cheung, F.B. Argonne National Lab., IL (United States). Sep 1992. 34p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. Order Number DE93010624. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The dissolution of the bottom head of a heavy water reactor into a pool of molten fuel under conditions of severe accidents is investigated. The main objectives are to determine the rate of dissolution-front propagation and to estimate the extent to which the bottom head is thinned owing to dissolution. A distributed parameter model is developed that extends the lumped-parameter model developed previously for transient analysis of dissolution of the interior surface of a reactor bottom head into a pool of molten aluminum. The extension takes into account both the variation of heat fluxes over the melt pool-bottom head interface and the variations of interface mass transfer with time and with position along the interface. The model consists mainly of partitioning the bottom head into a number of rings and analyzing the transient dissolution of each ring with a lumped-parameter model. For each of the rings, the dissolution is modeled using a mass transfer coefficient, the temperature distribution is considered to be one-dimensional and quasi-steady and the heat flux across the melt-bottom bead interface is modeled using a heat transfer coefficient. The distribution of the heat transfer coefficients is considered to be quasi-steady and is based on the scoping heat transfer calculation results obtained using the ACCORD code. The basic equations and their solution method for the distributed-parameter model are described. Comparisons of results from calculations using parameters pertaining to the reactor vessel in the original EBASCO full-size-plant design with those obtained previously using the lumped-parameter model are presented.

23621 (ANL/RE/CP–78569) **Numerical predictions of natural convection in a uniformly heated pool.** Tzanos, C.P. Cho, D.H. Argonne National Lab., IL (United States). [1993]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-930601–17: American Nuclear Society (ANS) annual meeting, San Diego, CA (United States), 20-24 Jun 1993). Order Number DE93012888. Source: OSTI; NTIS; INIS; GPO Dep.

In the event of a core meltdown accident, one of the accident progression paths is fuel relocation to the lower reactor plenum. In the heavy water new production reactor (NPR-HWR) design the reactor cavity is flooded with water. In such a design, decay heat removal to the water in the reactor cavity and thence to the containment may be adequate to keep the reactor vessel temperature below failure limits. If this is the case, the accident progression can be arrested by retaining a coolable corium configuration in the lower reactor plenum. The strategy of reactor cavity flooding to prevent reactor vessel failure from molten corium relocation to the reactor vessel lower head has also been considered for commercial pressurized water reactors. Previously, the computer code COMMIX-LAR/P was used to determine if the heat removal rate from the molten cerium in the lower plenum to the water in the cavity was adequate to keep the reactor vessel temperature in the NPR-HWR design below failure limits. It was found that natural convection in the molten pool resulted in heat removal rates that kept the peak reactor vessel temperature about 400°C below the steel melting point. The objective of the work presented in this paper was to determine whether COMMIX adequately predicts natural convection in a pool heated by a uniform heat source. For this purpose, the experiments of free convection in a semicircular cavity of Jahn and Reeneke were analyzed with COMMIX and code predictions were compared with experimental measurements. COMMIX is a general purpose thermalhydraulics code based on finite differencing by the first order upwind scheme.

23622 (BF-R–40.050-1) **Studies into primary gas releases into the reactor building of modular HTR. Project task: Computation of specific pathways. Final report.** Schimetschka, E.

Battelle-Institut e.V., Frankfurt am Main (Germany); Bundesministerium fuer Forschung und Technologie, Bonn (Germany). Feb 1992. 18p. (In German). Contract BMFT 03BTI2022. Order Number DE93792313. Source: OSTI; NTIS (US Sales Only); INIS.

Based on the current design status of the planned modular HTGR plant type 'HTR-2M', accident sequences involving spontaneous releases of gas or steam into the reactor building are analyzed. These analyses from the base upon which judgement is possible whether or not plant personnel is endangered by such accidents. This projet is a part of a larger undertaking aiming to reduce potential hazards to plant personnel, even in case of accident. (orig.).

23623 (BF-R--40.050-2) **Studies into primary gas releases into the reactor building of modular HTR. Project task: Computation of specific pathways. Summary report on the basic model of the case of a 'break of the external pressure equalizer line'.** Holzbauer, H.; Schimetschka, E. Battelle-Institut e.V., Frankfurt am Main (Germany). Dec 1991. 50p. (In German). Order Number DE93792314. Source: OSTI; NTIS (US Sales Only); INIS.

Based on the current design status of the planned modular HTGR plant type 'HTR-2M', calculations regarding conditions inside the reactor building after postulated break of the external pressure equalizer line are presented. The calculations are focused on gas distribution, local temperatures and aerosol behavior. The calculations are to quantify plant- internal effects expected from defined accident sequences for the current plant design. Against this baseline, improvements due to design improvements are to be compared in future. (orig.).

23624 (BF-R--40.050-3) **Studies into primary gas releases into the reactor building of modular HTR. Project task: Computation of specific pathways. Summary report on the basic model of the case of a 'main stream line break'.** Holzbauer, H.; Schimetschka, E. Battelle-Institut e.V., Frankfurt am Main (Germany). Jan 1992. 46p. (In German). Order Number DE93792315. Source: OSTI; NTIS (US Sales Only); INIS.

Based on the current design status of the planned modular HTGR plant type 'HTR- 2M', calculations regarding conditions inside the reactor building after postulated main steam line break upstream of the first isolation valve are presented. The calculations are focused on steam distribution and local heat loads. The calculations are to quantify plant-internal effects expected from defined accident sequences for the current plant design. Against this baseline, improvements due to design optimisation are to be compared in future. (orig.).

23625 (BNL-NUREG--47817) **Identification of important "PIUS" design considerations and accident sequences using qualitative plant assessment techniques.** Higgins, J.; Fullwood, R.; Kroeger, P.; Youngblood, R. Brookhaven National Lab., Upton, NY (United States). [1992]. 11p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-921007--22: 20. water reactor safety information meeting, Bethesda, MD (United States), 21-23 Oct 1992). Order Number DE93009326. Source: OSTI; NTIS; INIS; GPO Dep.

The PIUS (Process Inherent Ultimate Safety) reactor is an advanced design nuclear power plant that uses passive safety features and basic physical processes to address safety concerns. Brookhaven National Laboratory (BNL) performed a detailed study of the PIUS design for the NRC using primarily qualitative engineering analysis techniques. Some quantitative methods were also employed. There are three key initial areas of analysis: FMECA, HAZOP, and deterministic analyses, which are described herein. Once these three analysis methods were completed, the important findings from each of the methods were assembled into thePIUS Interim Table (PIT). This table thus contains a first cut sort of the important design considerations and features of the PIUS reactor. The table also identifies some potential initiating events and systems used for mitigating these initiators. The next stage of the analysis was the construction of event trees for each of the identified initiators. The most significant sequences were then determined qualitatively, using, some quantitative input. Finally, overall insights on the PIUS design developed from the PIT and from the event tree analysis were developed and presented.

23626 (BNL-NUREG--47971) **Level 1 probabilistic risk assessment of low power and shutdown operations at a PWR: Phase 2 results.** Chu, T.L. (Brookhaven National Lab., Upton, NY (United States)); Bozoki, G.; Kohut, P.; Musicki, Z.; Wong, S.M.; Yang, J.; Hsu, C.J.; Diamond, D.J.; Su, R.F.; Holmes, B.; Siu, N.; Bley, D.; Lin, J. Brookhaven National Lab., Upton, NY (United States). [1992]. 10p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-921007--27: 20. water reactor safety information meeting, Bethesda, MD (United States), 21-23 Oct 1992). Order Number DE93010937. Source: OSTI; NTIS; INIS; GPO Dep.

As a result of the Chernobyl accident and other precursor events (e.g., Diablo Canyon), the US Nuclear Regulatory Commission's (NRC's) Office of Nuclear Regulatory Research (RES) initiated an extensive project during 1989 to carefully examine the potential risks during Low Power and Shutdown (LP&S) operations. Shortly after the program began, an event occurred at the Vogtle plant during shutdown, which further intensified the effort of the LP&S program. In the LP&S program, one pressurized water reactor (PWR), Surry, and one boiling water reactor (BWR), Grand Gulf, were selected, mainly because they were previously analyzed in the NUREG-1150 Study. The Level-1 Program is being performed in two phases. Phase 1 was dedicated to performing a coarse screening level-1 analysis including internal fire and flood. A draft report was completed in November, 1991. In the phase 2 study, mid-loop operations at the Surry plant were analyzed in detail. The objective of this paper is to present the approach of the phase 2 study and the preliminary results and insights.

23627 (BNL-NUREG--48542) **MELCOR Verification, Benchmarking, and Applications experience at BNL.** Madni, I.K. Brookhaven National Lab., Upton, NY (United States). [1992]. 17p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-921007--21: 20. water reactor safety information meeting, Bethesda, MD (United States), 21-23 Oct 1992). Order Number DE93009331. Source: OSTI; NTIS; INIS; GPO Dep.

This paper presents a summary of MELCOR Verification, Benchmarking and Applications experience at Brookhaven National Laboratory (BNL), sponsored by the US Nuclear Regulatory Commission (NRC). Under MELCOR verification over the past several years, all released versions of the code were installed on BNL's computer system, verification exercises were performed, and defect investigation reports were sent to SNL. Benchmarking calculations of integral severe fuel damage tests performed at BNL have helped to identify areas of modeling strengths and weaknesses in MELCOR; the most appropriate choices for input parameters; selection of axial nodalization for core cells and heat structures; and workarounds that extend the capabilities of MELCOR. These insights are explored in greater detail in the paper, with the help of selected results and comparisons. Full plant applications calculations at BNL have helped to evaluate the ability of MELCOR to successfully simulate various accident sequences and calculate source terms to the environment for both BWRs and PWRs. A summary of results, including timing of key events, thermal-hydraulic response, and environmental releases of fission products are presented for selected calculations, along with comparisons with Source Term Code Package (STCP) calculations of the same sequences. Differences in results are explained on the basis of modeling differences between the two codes. The results of a sensitivity calculation are also shown. The paper concludes by highlighting some insights on bottomline issues, and the contribution of the BNL program to MELCOR development, assessment, and the identification of user needs for optimum use of the code.

23628 (BNL-NUREG--48687) **Development of a methodology for conducting an integrated HRA/PRA, Task 1: An assessment of human reliability influences during LP&S conditions in PWRs.** Luckas, W.J. (Brookhaven National Lab., Upton, NY (United States)); Barriere, M.T.; Brown, W.S.; Wreathall, J.; Cooper, S.E. Brookhaven National Lab., Upton, NY (United States). [1992]. 24p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-921007--28: 20. water reactor safety information meeting,

Bethesda, MD (United States), 21-23 Oct 1992). Order Number DE93014286. Source: OSTI; NTIS; INIS; GPO Dep.

During Low Power and Shutdown (LP&S) conditions in a nuclear power plant (i.e., when the reactor is subcritical or at less than 10–15% power), human interactions with the plant's systems will be more frequent and more direct. Control is typically not mediated by automation, and there are fewer protective systems available. Therefore, an assessment of LP&S related risk should include a greater emphasis on human reliability than such an assessment made for power operation conditions. In order to properly account for the increase in human interaction and thus be able to perform a probabilistic risk assessment (PRA) applicable to operations during LP&S, it is important that a comprehensive human reliability assessment (HRA) methodology be developed and integrated into the LP&S PRA. The tasks comprising the comprehensive HRA methodology development are as follows: (1) identification of the human reliability related influences and associated human actions during LP&S, (2) identification of potentially important LP&S related human actions and appropriate HRA framework and quantification methods, and (3) incorporation and coordination of methodology development with other integrated PRA/HRA efforts. This paper describes the first task, i.e., the assessment of human reliability influences and any associated human actions during LP&S conditions for a pressurized water reactor (PWR).

23629 (CONF-930803–10) **Warm prestress effects in fracture-margin assessment of PWR-RPVs.** Shum, D.K.M. Oak Ridge National Lab., TN (United States). [1993]. 6p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC05-84OR21400. From 12. biennial conference for the International Association for Structural Mechanics in Reactor Technology; Stuttgart (Germany); 16-20 Aug 1993. Order Number DE93013511. Source: OSTI; NTIS; INIS; GPO Dep.

This paper examines various issues that would impact the incorporation of warm prestress (WPS) effects in the fracture-margin assessment of reactor pressure vessels (RPVs). By way of an example problem, possible beneficial effects of including type-I WPS in the assessment of an RPV subjected to a small break loss of coolant accident are described. In addition, the need to consider possible loss of constraint effects when interpreting available small specimen WPS-enhanced fracture toughness data is demonstrated through two- and three-dimensional local crack-lip field analyses of a compact tension specimen. Finally, a hybrid correlative-predictive model of WPS base on J-Q theory and the Ritchie-Knott-Rice model is applied to a small scale yielding boundary layer formulation to investigate near crack-tip fields under varying degrees of loading and unloading.

23630 (CONF-930830–7) **Accurate representation of primary coolant system depressurization for high flux isotope reactor transients.** Wendel, M.W. Oak Ridge National Lab., TN (United States). [1993]. 18p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From National conference and exposition on heat transfer; Atlanta, GA (United States); 8-11 Aug 1993. Order Number DE93008267. Source: OSTI; NTIS; INIS; GPO Dep.

Because the High Flux Isotope Reactor primary coolant system is typically all liquid, the pressure falls very rapidly if a leak forms in the primary piping. This depressurization is the predominate phenomenon in the consideration of the loss-of-coolant-accident analysis that has been completed recently for the High Flux Isotope Reactor Safety Analysis Report. Small differences in the rate of depressurization can significantly affect the safety margin. A RELAP5 thermal-hydraulic input model has been developed, but the capabilities of the RELAP5 code do not automatically take into account the effect on the system pressure of a stretching or shrinkage in the pressure boundary. Because this change in the pressure boundary is so important in an all-liquid system, a scheme has been developed to account for the effect implementation of the structural elasticity model involved using the control variable capability of RELAP5. During simulated transients involving rapid pressure changes, mass is added to or taken away from the primary system depending on whether the system is decreasing or increasing in pressure. By doing so, a more realistic system response to transients involving significant pressure changes is obtained. The model has been used to perform various HFIR transient simulations including loss-of-coolant accidents (LOCAs), loss of offsite power, and loss-of-secondary-cooling transients. Results for a small break LOCA are presented with and without the elasticity model in place.

23631 (CONF-930830–19) **Analysis and modeling of flow blockage-induced steam explosion events in the High-Flux Isotope Reactor.** Taleyarkhan, R.P.; Georgevich, V.; Lestor, C.W.; Gat, U.; Lepard, B.L.; Cook, D.H.; Freels, J.; Chang, S.J.; Luttrell, C.; Gwaltney, R.C.; Kirkpatrick, J. Oak Ridge National Lab., TN (United States). [1993]. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From National conference and exposition on heat transfer; Atlanta, GA (United States); 8-11 Aug 1993. Order Number DE93013531. Source: OSTI; NTIS; INIS; GPO Dep.

This paper provides a perspective overview of the analysis and modeling work done to evaluate the threat from steam explosion loads in the High-Flux Isotope Reactor during flow blockage events. The overall workscope included modeling and analysis of core melt initiation, melt propagation, bounding and best-estimate steam explosion energetics, vessel failure from fracture, bolts failure from exceedance of elastic limits, and finally, missile evolution and transport. Aluminum ignition was neglected. Evaluations indicated that a thermally driven steam explosion with more than 65 MJ of energy insertion in the core region over several miliseconds would be needed to cause a sufficiently energetic missile with a capacity to cause early confinement failure. This amounts to about 65% of the HFIR core mass melting and participating in a steam explosion. Conservative melt propagation analyses have indicated that at most only 24% of the HFIR core mass could melt during flow blockage events under full-power conditions. Therefore, it is judged that the HFIR vessel and top head structure will be able to withstand loads generated from thermally driven steam explosions initiated by any credible flow blockage event. A substantial margin to safety was demonstrated.

23632 (EGG–2683) **Final report of the decontamination and decommissioning of the BORAX-V facility turbine building.** Arave, A.E.; Rodman, G.R. EG and G Idaho, Inc., Idaho Falls, ID (United States). Dec 1992. 45p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-76ID01570. Order Number DE93012142. Source: OSTI; NTIS; INIS; GPO Dep.

The Boiling Water Reactor Experiment (BORAX)-V Facility Turbine Building Decontamination and Decommissioning (D&D) Project is described in this report. The BORAX series of five National Reactor Testing Station (NRTS) reactors pioneered intensive work on boiling water reactor (BWR) experiments conducted between 1953 and 1964. Facility characterization, decision analyses, and D&D plans for the turbine building were prepared from 1979 through 1990. D&D activities of the turbine building systems were initiated in November of 1988 and completed with the demolition and backfill of the concrete foundation in March 1992. Due to the low levels of radioactivity and the absence of loose contamination, the D&D activities were completed with no radiation exposure to the workers. The D&D activities were performed in a manner that no radiological health or safety hazard to the public or to personnel at the Idaho National Engineering Laboratory (INEL) remain.

23633 (EGG-GEO–10304-Vol.2) **Earthquake ground motion evaluations for the proposed new production reactor at the Idaho National Engineering Laboratory: Volume 2, Probabilistic evaluation.** Coppersmith, K. (Woodward-Clyde Consultants, Oakland, CA (United States)); Wong, I.; Silva, W.; Hemphill-Haley, M.; Sawyer, T.; Youngs, R.; Stark, C.; Knuepfer, P.; Bruhn, R. EG and G Idaho, Inc., Idaho Falls, ID (United States); Woodward-Clyde Consultants, Oakland, CA (United States); Geomatrix Consultants, Inc., San Francisco, CA (United States); Pacific Engineering and Analysis, Inc., El Cerrito, CA (United States). Jun 1992. 112p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-76ID01570. Order Number DE93012264. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This volume describes and summarizes a probabilistic evaluation of ground motions for the proposed New Production Reactor (NPR) at the Idaho National Engineering Laboratory (INEL). The purpose of this evaluation is to provide input to Section 2.5.2 "Vibratory Ground Motion" of the INEL-NPR Integrated Safety Analysis Report

(ISAR). These probabilistic ground motion studies serve as a basis for evaluating the probability of exceeding the deterministic ground motion values determined for the NPR site.

23634 (EGG-M–92266) **Firewater system inadvertent actuation frequencies.** Schroeder, J.A. (EG and G Idaho, Inc., Idaho Falls, ID (United States)); Eide, S.A. EG and G Idaho, Inc., Idaho Falls, ID (United States). [1993]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-76ID01570. (CONF-930116–43: Probabilistic safety assessment international topical meeting (PSA 93), Clearwater Beach, FL (United States), 27-29 Jan 1993). Order Number DE93010801. Source: OSTI; NTIS; INIS; GPO Dep.

This paper presents some recommended generic values for fire protection system inadvertent actuation frequencies. The frequencies are based on actual data from Department of Energy and commercial reactor plant facilities.

23635 (EGG-M–92466) **Lessons learned from pilot errors using automated systems in advanced technology aircraft.** Nelson, W.R.; Byers, J.C.; Haney, L.N.; Ostrom, L.T.; Reece, W.J. EG and G Idaho, Inc., Idaho Falls, ID (United States). [1993]. 6p. Sponsored by National Aeronautics and Space Administration, Washington, DC (United States). DOE Contract AC07-76ID01570. (CONF-930401–13: Meeting on nuclear plant instrumentation, control and man-machine interface technologies, Oak Ridge, TN (United States), 18-21 Apr 1993). Order Number DE93010788. Source: OSTI; NTIS; GPO Dep.

The National Aeronautics and Space Administration (NASA) sponsored a project at the Idaho National Engineering Laboratory (INEL) to investigate pilot errors that occur during interaction with automated systems in advanced technology ("glass cockpit") aircraft. In particular, we investigated the causes and potential corrective measures for pilot errors that resulted in altitude deviation incidents (i.e. failure to capture or maintain the altitude assigned by air traffic control). To do this, we analyzed altitude deviation events that have been reported in the Aviation Safety Reporting System (ASRS), NASA's data base of incidents self-reported by pilots and air traffic controllers. We developed models of the pilot tasks that are performed to capture and maintain altitude. Two types of models were developed to provide complementary perspectives of these tasks: sequential models and functional models. Both types of models show the errors that occur in actual altitude deviation events in advanced technology aircraft. Then, errors from the ASRS data base were categorized according to the models, to help understand the potential causes of the different error types. This paper summarizes the methodology used to analyze pilot errors, the lessons learned from the study of altitude deviation errors, and the application of these results for the introduction of advanced technology in nuclear power plants.

23636 (EGG-M–92569) **Design, quallfication and operation of nuclear rockets for safe Mars missions.** Buden, D. (EG and G Idaho, Inc., Idaho Falls, ID (United States)); Madsen, W.W.; Olson, T.S.; Redd, L.R. EG and G Idaho, Inc., Idaho Falls, ID (United States). [1993]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-76ID01570. (CONF-930103–31: 10. symposium on space nuclear power and propulsion, Albuquerque, NM (United States), 10-14 Jan 1993). Order Number DE93010792. Source: OSTI; NTIS; INIS; GPO Dep.

Nuclear thermal propulsion modules planned for use on crew missions to Mars improve mission reliability and overall safety of the mission. This, as well as all other systems, are greatly enhanced if the system specifications take into account safety from design initiation, and operational considerations are well thought through and applied. For instance, the use of multiple engines in the propulsion module can lead to very high system safety and reliability. Operational safety enhancements may include: the use of multiple perigee burns, thus allowing time to ensure that all systems are functioning properly prior to departure from Earth orbit; the ability to perform all other parts of the mission in a degraded mode with little or no degradation of the mission; and the safe disposal of the nuclear propulsion module in a heliocentric orbit out of the ecliptic plane. The standards used to qualify nuclear rockets are one of the main cost drivers of the program. Concepts and systems that minimize cost and risk will rely on use of the element and component levels to demonstrate technology readiness and validation. Subsystem or systems testing then is only needed for verification of performance. Also, these will be the safest concepts because they will be more thoroughly understood and the safety margins will be well established and confirmed by tests.

23637 (HW–79228) **Nuclear safety criteria for special test loads – N-Reactor.** Nechodom, W.S.; Miller, N.R. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 14 Oct 1963. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93012369. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The initial fuel landing for the N-Reactor and the use of a specific alternative fuel element are described in a previous report. It is highly probable that it will also be desirable in the future to irradiate still other types of fuel elements in the reactor. If the test is of small scale, fever than five channels, or if these elements vary only slightly from the initial fuel load (or any other fuel type approved for large-scale use at some future date), the irradiation will be accomplished within the normal administrative procedures and controls established for the Production Testing Program. In this context, in-reactor testing of minor changes in the fuel cladding alloy, alternate methods of affixing end closures, different fuel support designs or similar changes are considered to be within the scope of normal productiontesting. It is possible, however, that it will be desirable to irradiate test fuel elements which are significantly different from any element approved for general use and in quantities of greater than five fuel columns at a given time. A more formalized review of such tests including approval by the AEC would appear appropriate in these instances. The purpose of this document is to outline criteria which can be usedto judge the stability of all such tests from the standpoint of reactor nuclear safety. It is intended that these criteria apply to test fuel loadings comprising up to 50 fuel columns within the reactor at a given time.

23638 (INIS-mf–13502) **Topform '92: the safe and reliable operation of LWR NPPs. Vol. I: Invited plenary session papers.** European Nuclear Society (ENS), Bern (Switzerland); Czech Nuclear Society, Prague (Czech Republic); Slovak Nuclear Society, Bratislava (Slovakia). Jan 1993. [235p.] (CONF-921068–: East-West topical meeting: the safe and reliable operation of light water reactor NPP's, Prague (Czechoslovakia), 18-21 Oct 1992). Order Number DE93626240. Source: OSTI; NTIS (US Sales Only); INIS.

The proceedings contain 23 invited plenary session papers. All have been inputted to INIS. The topics covered include safety principles, management and organization, operational training and simulation, inspection, maintenance and component replacement, backfitting experience, instrumentation, man-machine interface, software and procedures. (Z.S.).

23639 (INIS-mf–13502, pp. 18-27) **Towards world nuclear safety standards.** Hoegberg, L. (Swedish Nuclear Power Inspectorate, Stockholm (Sweden)). European Nuclear Society (ENS), Bern (Switzerland); Czech Nuclear Society, Prague (Czech Republic); Slovak Nuclear Society, Bratislava (Slovakia). Jan 1993. (CONF-921068–: East-West topical meeting: the safe and reliable operation of light water reactor NPP's, Prague (Czechoslovakia), 18-21 Oct 1992). In *Topform '92: the safe and reliable operation of LWR NPPs. Vol. I: Invited plenary session papers.* [235p.] Order Number DE93626240. Source: OSTI; NTIS (US Sales Only); INIS.

The achievement of world nuclear safety standards is interpreted as the achievement of high and reasonably uniform levels of safety throughout the world. The basic and principal elements of such an international nuclear safety regime are discussed against the background of the ongoing work on an international nuclear safety convention. Such principal elements include the national legal and institutional framework, the fundamental safety principles and, of particular importance, the mechanisms for demonstration of safety and compliance with an international safety regime seen as national obligations under an international safety convention. (author) 7 refs.

23640 (INIS-mf–14146) **Hochtemperatur-Kernkraftwerk GmbH (HKG). Annual report 1992.** Hochtemperatur-Kernkraftwerk GmbH (HKG), Hamm (Germany). 1993. 25p. (In German). Order Number DE93795324. Source: OSTI; NTIS (US Sales Only); INIS.

The report summarizes the business year and the current state of activities concerning shutdown operation, spent fuel management and the licensing procedure in progress. In depth information is given on the financial and business management aspects, as e.g. profit and loss account, methods applied for valuation and preparation of the balance sheet, and liabilities. (orig.).

23641 (JAERI-M–93-005) **Experimental study on a simulated primary-pipe rupture accident of HTGR: Experimental results of air ingress behavior.** Takeda, Tetsuaki (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Tokai Research Establishment); Takenaka, Satsuki; Hishida, Makoto; Emori, Koichi; Agake, Takashi. Japan Atomic Energy Research Inst., Tokyo (Japan). Feb 1993. 58p. (In Japanese). Order Number DE93797569. Source: OSTI; NTIS; INIS.

In order to investigate the air ingress process following a primary coolant pipe of the HTGR ruptures, we constructed an experimental apparatus simulating the reactor and the primary cooling system. A test model consists of a reactor core simulator, a top cover, a water cooled vessel, a coaxial pipe and so on. The reactor core simulator has four graphite pipes and a ceramic high-temperature plenum. The graphite pipes are heated by electric heaters up to 1200degC. The major results obtained in the present study are summarized in the followings: (1) During the early stage of the simulated pipe rupture in the present apparatus, air entered the test model by molecular diffusion and very weak natural convection of the gas mixture. After the density of the gas mixture in the test model gradually increased, the natural circulation of air was induced in the whole test model abruptly. The gases, carbon monoxide and carbon dioxide, generated by the oxidation reactions were transported by the molecular diffusion and by the very weak natural convection of the gas mixture during the early stage of this experiment. (2) In case of temperature (more than 900degC), the amount of carbon monoxide produced increased with increasing of the graphite temperature. The carbon monoxide reacted with oxygen (carbon monoxide combustion) in the high temperature regions remarkably and produced carbon dioxide. (3) The duration of the early stage, was about several days. (J.P.N.).

23642 (JAERI-M–93-015) **Safety analyses of a high conversion LWR with BWR type tight lattice core.** Okubo, Tsutomu (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Tokai Research Establishment); Osugi, Toshitaka; Tomiai, Ichio. Japan Atomic Energy Research Inst., Tokyo (Japan). Feb 1993. 83p. (In Japanese). Order Number DE93797570. Source: OSTI; NTIS; INIS.

Although a high conversion LWR with a BWR type tight lattice core is an attractive reactor type due to its high conversion ratio of over 1.0 when we consider its effect on future reactor introduction, there would be some issues to be resolved, especially in the field of core cooling characteristics, due to its higher degree of tightness than ever. Therefore, as a part of the investigation on core cooling characteristics of this reactor, safety analyses on the critical heat flux characteristics under the steady state and the representative LOCA events of the high pressure core flooder piping break accident and the feed water piping break accident have been performed. Evaluation of the critical heat flux under the steady state has been performed with the KfK correlation. The results are severe ones from the thermodynamic point of view. They, however, show the minimum critical heat flux ratio of about 1.3 can be attained for the rod with the local power ratio of 1.2 and facing a subchannel surrounded by three of this type of rod in the fuel assembly with the power ratio of 1.3 by increasing the water flow rate by 20 percent in the high power fuel assembly than the average. Analyzed results with RETRAN code for those two LOCAs have shown the core is kept sufficiently cooled without any problems. The maximum core temperature calculated for a rod with the local power ratio of 1.2 in the fuel assembly with the power ratio of 1.3 in the high pressure core flooder piping break accident, which has given the severe results than the other, is around 670degC just after the accident initiation. Then, after 20 s, the core temperature is kept under about 300degC. (author).

23643 (JAERI-M–93-039) **Analysis of ROSA-IV/LSTF experiment simulating a steam generator tube rupture design basis incident by using RELAP5/MOD2 code.** Watanabe, Tadashi (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Tokai Research Establishment); Kukita, Yutaka; Wang, Ming. Japan Atomic Energy Research Inst., Tokyo (Japan). Mar 1993. 33p. (In Japanese). Order Number DE93797602. Source: OSTI; NTIS; INIS.

The experiment (Run SB-SG-07), which simulated the design-basis steam generator tube rupture (SGTR) scenario for a pressurized water reactor (PWR), was conducted at the ROSA-IV/LSTF. The analysis of this experiment was performed by using the RELAP5/MOD2 code, and the predictive capability of the code for the characteristic phenomena in SGTR incidents was assessed against experimental data. This experiment and the analysis were performed after the experiment simulating the Mihama Unit-2 SGTR incident (Run SB-SG-06) and its analysis. The analytical results predicted well the behavior of major parameters in the experiment. However, in details, the following differences between the experiment and the analysis were found. The break flow rate was slightly overestimated immediately after the break. This was related to the experimental uncertainty in the initial fluid temperature in the break line. The increase in pressurizer water level was underestimated during the depressurization of primary side by opening the pressurizer power operated relief valve (PORV). The primary pressure was overestimated after the closing of the PORV. The secondary side liquid levels were overestimated in both the SGs, as was the case with the SB-SG-06 analysis. In the analysis, the decrease in the upper head fluid temperature was almost the same as that in the former experiment, but larger than that in this experiment. From the SB-SG-06 and SB-SG-07 analyses, several problems were found in the SGTR analysis by using RELAP5/MOD2 such as (1) the criterion for the horizontal stratification, and (2) the interfacial heat transfer model in the vertical stratification model. (author).

23644 (LA–12481) **SCDAP/RELAP5 independent peer review.** Corradini, M.L. (Wisconsin Univ., Madison, WI (United States). Dept. of Nuclear Engineering); Dhir, V.K.; Haste, T.J.; Heames, T.J.; Jenks, R.P.; Kelly, J.E.; Khatib-Rahbar, M. Los Alamos National Lab., NM (United States). Jan 1993. 357p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract W-7405-ENG-36. Order Number DE93011569. Source: OSTI; NTIS; INIS; GPO Dep.

The SCDAP/RELAP5 code has been developed for best-estimate transient simulation of light-water-reactor coolant systems during severe accidents. The newest version of the code is SCDAP/RELAP5/MOD3. The US Nuclear Regulatory Commission (NRC) decided that there was a need for a broad technical review of the code by recognized experts to determine overall technical adequacy, even though the code is still under development. For this purpose, an eight-member SCDAP/RELAP5 Peer Review Committee was organized, and the outcome of the review should help the NRC prioritize future code-development activity. Because the code is designed to be mechanistic, the Committee used a higher standard for technical adequacy than was employed in the peer review of the parametric MELCOR code. The Committee completed its review of the SCDAP/RELAP5 code, and the findings are documented in this report. Based on these findings, recommendations in five areas are provided: (1) phenomenological models, (2) code-design objectives, (3) code-targeted applications, (4) other findings, and (5) additional recommendations.

23645 (LA-UR–92-3503) **Natural-circulation flow pattern during the gamma-heating phase of an LBLOCA in a heavy-water moderated reactor.** Rodriguez, S.B.; Unal, C.; Pasamehmetoglu, K.O.; Motley, F.E. Los Alamos National Lab., NM (United States). [1992]. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930352–17: 2. international conference on nuclear engineering, San Francisco, CA (United States), 21-24 Mar 1993). Order Number DE93012447. Source: OSTI; NTIS; INIS; GPO Dep.

In a postulated large-break loss-of-coolant accident (LBLOCA), the core of the reactor is uncovered quickly as the liquid that drains out of the tank is replaced by air. During the LBLOCA, the reactor is scrammed. the moderator tank is drained, and fuel and control rod tubes are cooled internally by forced convection via the emergency cooling system (ECS) water. However, the safety rods, reflector assemblies, tank wall, and instrument rods continue to heat up as a result of gamma deposition. These components are primarily cooled by natural/mixed convection and radiation heat

transfer. In this paper, the thermal-hydraulic analysis of a reactor moderator tank exposed to air during an LBLOCA is discussed. The analysis was performed using a special version of the Transient Reactor Analysis Code (TRAC). TRAC input and code modifications considered the appropriate modeling of ECS cooling, thermal radiation heat transfer, and natural convection. The major objective of the model was to calculate the limiting component temperature (that establishes the maximum operating power) as a result of gamma heating. In addition, the nature of the moderator tank air-circulation pattern and its effects on the limiting temperature under various conditions were analyzed. None of the components were found to exceed their structural limits when the pre-scram power level was 50% of historical power.

23646 (LA-UR–93-268) **Simplified dynamic buckling assessment of steel containments.** Farrar, C.R.; Duffey, T.A.; Renick, D.H. Los Alamos National Lab., NM (United States). [1993]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930803–2: 12. biennial conference for the International Association for Structural Mechanics in Reactor Technology, Stuttgart (Germany), 16-20 Aug 1993). Order Number DE93007373. Source: OSTI; NTIS; INIS; GPO Dep.

A simplified, three-degree-of-freedom analytical procedure for performing a response spectrum buckling analysis of a thin containment shell is developed. Two numerical examples with R/t values which bound many existing steel containments are used to illustrate the procedure. The role of damping on incipient buckling acceleration level is evaluated for a regulatory seismic spectrum using the two numerical examples. The zero-period acceleration level that causes incipient buckling in either of the two containments increases 31% when damping is increased from 1% to 4% of critical. Comparisons with finite element results on incipient buckling levels are favorable.

23647 (LA-UR–93-269) **Dynamic buckling of containments: The influence of damping.** Farrar, C.R.; Duffey, T.A.; Goldman, P.A.; Bennett, J.G. Los Alamos National Lab., NM (United States). [1993]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930803–3: 12. biennial conference for the International Association for Structural Mechanics in Reactor Technology, Stuttgart (Germany), 16-20 Aug 1993). Order Number DE93007372. Source: OSTI; NTIS; INIS; GPO Dep.

The seismic buckling capacities of representative thin, unstiffened elastic containment shells are investigated to evaluate the sensitivity of buckling to the damping level. The finite element method with transient time integration is utilized with both actual earthquake acceleration-time signals and artificial time histories generated from regulatory spectra. The dynamic response and subsequent buckling of the selected containment shells are found to be highly dependent on both damping level and the degree to which the input signal excites the fundamental shear-bending mode of the shell. Transient stresses and buckling levels for the two containment shells induced by the seismic inputs were reduced in the range of 12% to 111% by increasing the damping level from 1% to 4% of critical.

23648 (NUREG–0090-Vol.15-No.4) **Report to Congress on abnormal occurrences, October–December 1992: Volume 15, No. 4.** Nuclear Regulatory Commission, Washington, DC (United States). Office for Analysis and Evaluation of Operational Data. Mar 1993. 22p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). Source: OSTI; NTIS; INIS; GPO.

Section 208 of the Energy Reorganization Act of 1974 identifies an abnormal occurrence as an unscheduled incident or event that the Nuclear Regulatory Commission determines to be significant from the standpoint of public health or safety and requires a quarterly report of such events to be made to Congress. This report covers the period from October 1 through December 31, 1992. There are two abnormal occurrences at nuclear power plants and six abnormal occurrences involving medical misadministration (all therapeutic) at NRC-licensed facilities discussed in this report. No abnormal occurrences were reported by the NRC's Agreement States. The report also contains information updating three previously reported abnormal occurrences.

23649 (NUREG–0797-Suppl.27) **Safety evaluation report related to the operation of Comanche Peak Steam Electric Station, Unit 2 (Docket No. 55-446).** Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Reactor Regulation. Apr 1993. 44p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). Source: OSTI; NTIS; INIS; GPO.

Supplement 27 to the Safety Evaluation Report related to the operation of the Comanche Peak Steam Electric Station (CPSES), Unit 2 (NUREG-0797), has been prepared by the Office of Nuclear Reactor Regulation of the US Nuclear Regulatory Commission (NRC). The facility is located in Somervell County, Texas, approximately 40 miles southwest of Fort Worth, Texas. This supplement reports the status of certain issues that had not been resolved when the Safety Evaluation Report and Supplements 1, 2, 3, 4, 6, 12, 21, 22, 23, 24, 25, and 26 to that report were published. This supplement deals primarily with Unit 2 issues. This twenty-seventh supplement, which is in support of the full-power license for Unit 2, provides updated information on the issues that had been considered previously, as well as the evaluation of issues that havearisen since the twenty-sixth supplement was issued. This evaluation addresses all of the issues necessary to support the issuance of a full-power license for Unit 2.

23650 (NUREG–1125-Vol.14) **A compilation of reports of the Advisory Committee on Reactor Safeguards: 1992 Annual: Volume 14.** Nuclear Regulatory Commission, Washington, DC (United States). Apr 1993. 186p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). Source: OSTI; NTIS; INIS; GPO.

This compilation contains 50 ACRS reports submitted to the Commission, Executive Director for Operations, or to the Office of Nuclear Regulatory Research, during calendar year 1992. It also includes a report to the Congress on the NRC Safety Research Program. All reports have been made available to the public through the NRC Public Document Room and the US Library of Congress. The reports are divided into two groups: Part 1: ACRS Reports on Project Reviews, and Part 2: ACRS Reports on Generic Subjects. Part I contains ACRS reports alphabetized by project name and by chronological order within project name. Part 2 categorizes the reports by the most appropriate generic subject area and by chronological order within subject area.

23651 (NUREG–1485) **Unauthorized forced entry into the protected area at Three Mile Island Unit 1 on February 7, 1993.** Nuclear Regulatory Commission, Washington, DC (United States). Apr 1993. 128p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). Source: OSTI; NTIS; INIS; GPO.

On February 7, 1993, at 6:53 a.m. Eastern Standard Time (EST) an intruder drove into tile site owner-controlled area, through a gate into the protected area of Three Mile Island Nuclear Generating Station, Unit I (TMI-1) and crashed through a roll-up door on the Turbine Building. TMI Security reported this event to the US Nuclear Regulatory Commission's (NRC's) Headquarters operations officer and declared a Security Emergency upon determining that the protected area of the plant had been compromised. At 7:23 a.m., the TMI-1 shift supervisor officially notified the NRC Headquarters operations officer that he had declared a Site Area Emergency effective at 7:05 a.m. Upon considering the possible significance to physical security and the regulatory questions that could result from the event, the NRC Executive Director for Operations established an incident investigation team to determine what happened and make appropriate findings and conclusions. In this report the team described the event and the response to the event, evaluated the regulatory requirements, and presented the team's findings and conclusions.

23652 (NUREG/CP–0126-Vol.1) **Proceedings of the US Nuclear Regulatory Commission twentieth water reactor safety information meeting: Volume 1, Plenary session, Advanced reactor research, Advanced passive LWRs, Advanced instrumentation and control hardware, Advanced control system technology, Human factors research, EPRI's nuclear safety research and development.** Weiss, A.J. (comp.) (Brookhaven National Lab., Upton, NY (United States)). Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY

(United States). Mar 1993. 524p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-921007–Vol.1: 20. water reactor safety information meeting, Bethesda, MD (United States), 21-23 Oct 1992). Source: OSTI; NTIS; INIS; GPO.

This three-volume report contains papers presented at the Twentieth Water Reactor Safety Information Meeting held at the Bethesda Marriott Hotel, Bethesda, Maryland, during the week of October 21–23, 1992. The papers describes progress and results of programs in nuclear safety research conducted in this country and abroad. Foreign participation in the meeting included 10 different papers presented by researchers from CEC, China, Finland, France, Germany, Japan, Spain and Taiwan. This document, Volume 1, presents, papers on: Advanced Reactor Research; Advanced passive LWR's; advanced instrumentation and control hardware, advanced control system technology; human factors research; and EPRI's nuclear safety research and development. The individual papers have been cataloged separately.

23653 (NUREG/CP–0126-Vol.2) **Proceedings of the US Nuclear Regulatory Commission twentieth water reactor safety information meeting: Volume 2, Severe accident research, Thermal hydraulics.** Weiss, A.J. (comp.) (Brookhaven National Lab., Upton, NY (United States)). Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (United States). Mar 1993. 568p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). (CONF-921007–Vol.2: 20. water reactor safety information meeting, Bethesda, MD (United States), 21-23 Oct 1992). Source: OSTI; NTIS; INIS; GPO.

This three-volume report contains papers presented at the Twentieth Water Reactor Safety Information Meeting held at the Bethesda Marriott Hotel, Bethesda, Maryland, during the week of October 21–23, 1992. The papers describe progress and results of programs in nuclear safety research conducted in this country and abroad. Foreign participation in the meeting included 10 different papers presented by researchersfrom CEC, China, Finland, France, Germany, Japan, Spain and Taiwan.

23654 (NUREG/CP–0126-Vol.3) **Proceedings of the US Nuclear Regulatory Commission twentieth water reactor safety information meeting: Volume 3, Aging research developments, Primary system integrity, Structural and seismic engineering, Earth sciences, Probabilistic risk assessment topics.** Weiss, A.J. (comp.) (Brookhaven National Lab., Upton, NY (United States)). Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (United States). Mar 1993. 567p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-921007–Vol.3: 20. water reactor safety information meeting, Bethesda, MD (United States), 21-23 Oct 1992). Source: OSTI; NTIS; INIS; GPO.

This three-volume report contains papers presented at the Twentieth Water Reactor Safety Information Meeting held at the Bethesda M–23, 1992. The papers describe progress and results of programs in nuclear safety research conducted in this country and abroad. Foreign participation in the meeting included 10 different papers presented by researchers from CEC, China, Finland, France, Germany, Japan, Spain and Taiwan. This document, Volume 3, presents papers on: Aging research development; primary system integrity; structural and seismic engineering, earth sciences, and probabilistic risk assessment topics. The individual papers have been cataloged separately.

23655 (NUREG/CR–4273) **Crack propagation in high strain regions of Sequoyah containment.** Greimann, L. (Ames Lab., IA (United States)); Fanous, F.; Bluhm, D. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Engineering; Ames Lab., IA (United States). Mar 1993. 47p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract W-7405-ENG-82. (IS–4878). Source: OSTI; NTIS; INIS; GPO.

The rate of release of radioactive materials from a containment during a severe accident has a significant impact on the consequences of the accident. One hypothesis for a containment leakage model states that the containment will develop a controlled, relatively small leak before the pressure reaches the point where a general rupture of the shell occurs. Another states that overall failure will occur with total release of the vessel contents almost instantaneously. The Sequoyah ice condenser containment vessel has been studied for some time to predict the possible location and extent of leakage which could occur during a severe accident. In this work, three critical high strain locations were studied to predict crack propagation from an initially small defect. The 1/2-inch plate near the Sequoyah springline was selected for further study. A detailed finite element model of the region was prepared and a virtual crack extension method for calculating the J integral was developed for use with the general purpose finite element program. The pressure in the model was increased to 78 psi which produced a maximum membrane strain of 6.5 percent. At this point the surface crack was assumed to propagate through the plate and leakage began. Using the virtual crack extension method, two through cracks with different lengths were found to be unstable at this pressure which would allow almost instantaneous release of the vessel contents.

23656 (NUREG/CR–4551-Vol.7-Rev.1-Pt.1) **Evaluation of severe accident risks: Zion, Unit 1, Main report: Volume 7, Revision 1, Part 1.** Park, C.K. (Korea Advanced Energy Research Inst., Daeduk (Korea, Republic of). Dept. of Nuclear Reactor Safety Research); Cazzoli, E.G.; Grimshaw, C.A.; Tingle, A.; Pratt, W.T.; Lee, M. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Safety Issue Resolution; Brookhaven National Lab., Upton, NY (United States). Mar 1993. 226p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC02-76CH00016. (BNL-NUREG–52029-Vol.7-Rev.1-Pt.1). Source: OSTI; NTIS; INIS; GPO.

In support of the Nuclear Regulatory Commission's (NRC's) assessment of the risk from severe accidents at commercial nuclear power plants in the US reported in NUREG-1150, revised calculation of the risk to the general public from severe accidents at the Zion Power Station, Unit 1 has been completed. This power plant, located on the western shore of Lake Michigan on the outskirts of Zion, is operated by the Commonwealth Edison Company. The emphasis in this risk analysis was not on determining a "so-called" point estimate of risk. Rather, it was to determine the distribution of risk, and to discover the uncertainties that account for the breadth of this distribution. Off-site risk initiation by events, both internal to the power station and external to the power station was assessed.

23657 (NUREG/CR–4551-Vol.7-Rev.1-Pt.2A) **Evaluation of severe accident risks, Zion, Unit 1: Appendix A: Volume 7, Revision 1, Part 2A.** Park, C.K. (Korea Advanced Energy Research Inst., Daeduk (Korea, Republic of). Dept. of Nuclear Reactor Safety Research); Cazzoli, E.G.; Grimshaw, C.A.; Tingle, A.; Pratt, W.T.; Lee, M. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Safety Issue Resolution; Brookhaven National Lab., Upton, NY (United States). Mar 1993. 658p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC02-76CH00016. (BNL-NUREG–52029-Vol.7-Rev.1-Pt.2A). Source: OSTI; NTIS; INIS; GPO.

In support of the Nuclear Regulatory Commission's (NRC's) assessment of the risk from severe accidents at commercial nuclear power plants in the US reported in NUREG-1150, revised calculation of the risk to the general public from severe accidents at the Zion Power Station, Unit 1 has been completed. This power plant, located on the western shore of Lake Michigan on the outskirts of Zion, is operated by the Commonwealth Edison Company. The emphasis in this risk analysis was not on determining a "so-called" point estimate of risk. Rather, it was to determine the distribution of risk, and to discover the uncertainties that account for the breadth of this distribution. Off-site risk initiation by events, both internal to the power station and external to the power station was assessed. This document, Vol. 7, Rev. 1, Part 2A contains appendix A of this report.

23658 (NUREG/CR–4551-Vol.7-Rev.1-Pt.2B) **Evaluation of severe accident risks, Zion, Unit 1: Appendices B, C, D, and E: Volume 7, Revision 1, Part 2B.** Park, C.K. (Korea Advanced Energy Research Inst., Daeduk (Korea, Republic of). Dept. of Nuclear Reactor Safety Research); Cazzoli, E.G.; Grimshaw, C.A.;

Tingle, A.; Pratt, W.T.; Lee, M. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Safety Issue Resolution; Brookhaven National Lab., Upton, NY (United States); National Tsing Hua Univ., Hsinchu (Taiwan, Province of China). Dept. of Nuclear Engineering. Mar 1993. 375p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC02-76CH00016. (BNL-NUREG–52029-Vol.7-Rev.1-Pt.2B). Source: OSTI; NTIS; INIS; GPO.

In support of the Nuclear Regulatory Commission's (NRC's) assessment of this risk from severe accidents at commercial nuclear power plants in the US reported in NUREG-1150, revised calculation of the risk to the general public from severe accidents at the Zion Power Station, Unit 1 has been completed. This power plant, located on the western shore of the Lake Michigan on the outskirts of Zion, is operated by the Commonwealth Edison Company. The emphasis in this risk analysis was not on determining a "so-called" point estimate of risk. Rather, it was to determine the distribution of risk, and to discover the uncertainties that account for the breadth of this distribution. Off-site risk initiation by events, both internal to the power station and external to the power station was assessed. This document, Vol. 7, Rev. 1, Part 2B contains appendices B, C, D, and E.

23659 (NUREG/CR–4832-Vol.9) **Analysis of the LaSalle Unit 2 Nuclear Power Plant: Risk Methods Integration and Evaluation Program (RMIEP): Volume 9.** Lambright, J.A. (Sandia National Labs., Albuquerque, NM (United States)); Brosseau, D.A.; Payne, A.C. Jr.; Daniel, S.L. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Safety Issue Resolution; Sandia National Labs., Albuquerque, NM (United States). Mar 1993. 702p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC04-76DP00789. (SAND–92-0537-Vol.9). Source: OSTI; NTIS; INIS; GPO.

This report is a description of the internal fire analysis performed on the LaSalle County Nuclear Generating Station, Unit II. Insights gained from the NUREG-1150 fire analyses of Peach Bottom and Surry were used to the greatest extent possible in this risk assessment. As part of this effort, a new data base for fires was constructed (NUREG/CR-4586). This data base aided in quantification of initiating event frequencies. The most detailed integration with internal events analysis to date in fire risk assessment was also accomplished. The same system fault trees used for internal events were utilized in the fire analysis, which included modeling of components down to the contact pair level. Subsidiary equations were created to map the effects of cable failures and spurious actuations. For all components modeled in the internal event fault trees, associated cables were identified and component and cable locations were traced and mapped into the fault trees. A detailed screening analysis was performed which showed most plant areas had a negligible contribution to fire-induced core damage frequency. A detailed analysis of the fire risk resulted in a total (mean) core damage frequency of 3.21E-5 per year.

23660 (NUREG/CR–5801) **Procedure for analysis of common-cause failures in probabilistic safety analysis.** Mosleh, A. (Maryland Univ., College Park, MD (United States). Dept. of Materials and Nuclear Engineering). Nuclear Regulatory Commission, Washington, DC (United States). Div. of Safety Issue Resolution; Sandia National Labs., Albuquerque, NM (United States); Maryland Univ., College Park, MD (United States). Dept. of Materials and Nuclear Engineering. Apr 1993. 45p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC04-76DP00789. (SAND–91-7087). Source: OSTI; NTIS; INIS; GPO.

This report provides practical guidelines for treatment of common-cause failures (CCF) in risk and reliability studies. The procedures outlined in this report are organized according to three phases of analysis, screening analysis, detailed qualitative analysis, and detailed quantitative analysis. The results of the screening analysis phase include conservative identification of potential common-cause vulnerabilities and determination of the scope and focus for more detailed analysis in Phases II and III. Phase II, the detailed qualitative analysis, provides a better understanding of the plant-specific susceptibilities of the systems and components to causes and coupling mechanisms of CCF. The information from this phase can then be used as a basis for a plant-specific quantitative assessment of CCF frequencies. Detailed guidelines are provided for Phase III to aid the analyst in using this qualitative information and generic data in developing a plant-specific CCF base. Depending on the overall objective of the study, CCF analysis can stop at the end of any of the three phases.

23661 (NUREG/CR–5937) **Intentional depressurization accident management strategy for pressurized water reactors.** Brownson, D.A. (EG and G Idaho, Inc., Idaho Falls, ID (United States)); Haney, L.N.; Chien, N.D. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Systems Research; EG and G Idaho, Inc., Idaho Falls, ID (United States). Apr 1993. 173p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC07-76ID01570. (EGG–2688). Source: OSTI; NTIS; INIS; GPO.

In a previous investigation of the Surry nuclear power station, it was concluded that intentional depressurization of the reactor coolant system (RCS) could prevent or mitigate the effects of direct containment heating (DCH) during a station blackout transient. Two strategies, early and late depressurization, were investigated as methods to mitigate DCH. The investigation concluded that since there are greater opportunities to recover plant functions before core damage occurs and operator response uncertainties are lessened, the strategy of late depressurization is preferred over early depressurization. The results of the Surry analysis were extended to other US pressurized water reactors (PWRS) in order to evaluate their capability to successfully employ the late depressurization strategy to prevent or mitigate DCH. By applying appropriate scaling factors to the selected key parameters, this evaluation resulted in the categorization of four PWR groups based upon their perceived late depressurization capability. In this report, a PWR representative of each of the four PWR groups was chosen for detailed analysis of its capability to intentionally depressurize employing the late depressurization strategy. The phenomenological behavior, hardware performance, and operational performance of these PWRs during the intentional depressurization strategy were considered. The phenomenological behavior was analyzed using the SCDAP/RELAP5/MOD3 severe accident analysis code. The results of these evaluations were then extended to the remaining PWRs comprising each PWR group.

23662 (NUREG/CR–5976) **Development and use of a train-level probabilistic risk assessment.** Smith, C.L. (EG and G Idaho, Inc., Idaho Falls, ID (United States)); Fowler, R.D.; Wolfram, L.M. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Safety Issue Resolution; EG and G Idaho, Inc., Idaho Falls, ID (United States). Apr 1993. 71p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC07-76ID01570. (EGG–2694). Source: OSTI; NTIS; INIS; GPO.

The Idaho National Engineering Laboratory examined the potential for the development of train-level probabilistic risk assessment (PRA) databases. These train-level databases will allow the Nuclear Regulatory Commission to investigate effects on plant core damage frequency (CDF) given a train is failed or taken out of service. The intent of this task was to develop user-friendly databases that required a minimalamount of personnel involvement to be usable. It was originally intended that the train-level models would not be expanded to include basic events below the top gate of a train, with the possible exception of including some of the major train-related components (e.g., important pumps and motor-operated valves). It was found that a database similar to the original plant PRA provided the accuracy needed to measure the changes in plant CDF. The Peach Bottom Unit 2 NUREG-1150 PRA (a large fault tree model) and the Beaver Valley Unit 2 IPE (a large event tree model) were selected to demonstrate the feasibility of developing train-level databases. Five different methods for developing train-level databases were hypothesized and are examined. Ultimately, two train-level databases were developed using the Peach Bottom Unit 2 PRA and onetrain-level database was developed using the Beaver Valley Unit 2 IPE. The development, use, limitations, and results of these train-level databases are discussed.

23663 (NUREG/CR–6011) **Review of structure damping values for elastic seismic analysis of nuclear power plants.**

Hashimoto, P.S. (EQE Engineering Consultants, Irvine, CA (United States)); Steele, L.K.; Johnson, J.J.; Mensing, R.W. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Engineering; EQE Engineering Consultants, Irvine, CA (United States). Mar 1993. 711p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). Source: OSTI; NTIS; INIS; GPO.

Current US Nuclear Regulatory Commission guidance on structure damping values for elastic seismic design analysis of nuclear power plants are contained in Regulatory Guide 1.61 (R.G. 1.61). The objectives of the study described in this report are to investigate the adequacy of R.G1.61 structure damping values based on currently available data, and to recommend revisions to R.G. 1.61 as appropriate. Measured structure damping values, and associated structure, foundation, excitation, and input/response parameters, were collected and compiled. These data were analyzed to identify the parameters that significantly influence structure damping and to quantify structure damping in terms of these parameters. Based on this study, current R.G. 1.61 damping values for structure design are either adequate, or require only minor revision, depending on the structure material. More explicit guidance on structure damping values for seismic analysis to determine input to equipment has been prepared, along with other recommendations to improve the applicability of R.G. 1.61.

23664 (NUREG/CR–6027) **Preliminary evaluation of snubber single failures.** Ware, A.G. (EG and G Idaho, Inc., Idaho Falls, ID (United States)); Blandford, R.K.; Kelly, D.L.; Morton, D.K.; Nitzel, M.E. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Safety Issue Resolution; EG and G Idaho, Inc., Idaho Falls, ID (United States). Apr 1993. 49p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC07-76ID01570. (EGG–2697). Source: OSTI; NTIS; INIS; GPO.

The United States Nuclear Regulatory Commission developed FIN L2430, Preliminary Evaluation of Snubber Single Failures, with the objective of performing a preliminary evaluation of the safety implication of a potential single failure of a snubber used to support safety-related piping or equipment. The Idaho National Engineering Laboratory staff conducted a qualitative review of a large number of light water reactor systems, and a quantitative stress analysis of four systems. A candidate list was developed that ranked the systems as having a high, medium, or low probability of causing a significant increase in the core damage frequency should a single snubber fail to function. Two systems were ranked high, a Westinghouse PWR ice condenser main steam containment penetration and a General Electric BWR Mark I torus. Six systems were ranked medium and the remaining 30 were ranked as low or low-to-medium. The two systems ranked high and two systems ranked medium, a Westinghouse PWR ice condenser auxiliary feedwater line and a Combustion Engineering PWR System 80 reactor coolant system loop drain line, were chosen for a quantitative stress analysis. Of the four systems analyzed, only the PWR ice condenser main steam containment penetration is judged to be significantly susceptible to the failure of a single snubber.

23665 (ORNL/FTR–4432) **Boiling Water Reactor Core Melt Progression Phenomena Program: Foreign trip report, September 19–October 10, 1992.** Ott, L.J. Oak Ridge National Lab., TN (United States). 14 Oct 1992. 24p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93009221. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The Statement of Work (August 1992) for the Boiling Water Reactor (BWR) Core Melt Progression Phenomena Program at Oak Ridge National Laboratory (ORNL) provides for pretest and posttest analyses of CORA BWR experiments performed at KfK and for participation in the dry core CORA test (CORA-33). The traveler provided assistance to the CORA experimental staff in the preparation of experimental test conditions and experimental test procedure for CORA-33. The traveler attended the 1992 International CORA Workshop and the OECD/NEA ISP-31 Workshop at KfK, FRG. Participation included the presentation of a paper on work performed by the Boiling Water Reactor Core Melt Progression Phenomena Program on pretest and posttest analyses of CORA BWR experiments.

23666 (ORNL/FTR–4433) **[Advanced Light Water Reactor (ALWR) Utility Requirements Document Program]: Foreign trip report, September 27–October 4, 1992.** White, J.D. Oak Ridge National Lab., TN (United States). 16 Oct 1992. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93009930. Source: OSTI; NTIS (US Sales Only); GPO Dep.

To participate in the DOE/Electric Power Research Institute Advanced Light Water Reactor (ALWR) Utility Requirements Document Program visit to the French utility instrumentation and control facilities and to the thermal-hydraulic test facilities near Milan and to participate in the Utility Steering Committee Meeting in Rome. This travel was part of current programmatic assignments which are: to review the requirements documents being generated for the ALWR, and to perform R&D on the use of computer-based technologies in the control systems being developed for the DOE-sponsored Advanced Liquid Metal Reactor (ALMR).

23667 **Nuclear reactor flow control method and apparatus.** Church, J.P. To Dept. of Energy. 23 Apr 1991. USA patent application 7-689,425. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE93012016. Source: OSTI; NTIS; INIS; GPO Dep.

This document describes method and apparatus for improving coolant flow in a nuclear reactor during accident as well as nominal conditions. The reactor has a plurality of fuel elements in sleeves and a plenum above the fuel and through which the sleeves penetrate. Holes are provided in the sleeve so that coolant from the plenum can enter the sleeve and cool the fuel. The number and size of the holes are varied from sleeve to sleeve with the number and size of holes being greater for sleeves toward the center of the core and less for sleeves toward the periphery of the core. Preferably the holes are all the same diameter and arranged in rows and columns, the rows starting from the bottom of every sleeve and fewer rows in peripheral sleeves and more rows in the central sleeves.

23668 (PNL-SA–21833) **A computer program for estimating decommissioning costs for light water reactors.** Bierschbach, M.C. Pacific Northwest Lab., Richland, WA (United States). Feb 1993. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-930205–32: Waste management '93, Tucson, AZ (United States), 28 Feb - 4 mar 1993). Order Number DE93009476. Source: OSTI; NTIS; INIS; GPO Dep.

This report discusses a desk-top computer program has been developed for estimating the costs, waste volumes, and occupational radiation exposures associated with decommissioning light-water reactor power stations. Cost categories and cost algorithms used in the program are discussed and a brief description of the user interface is given.

23669 (SAND–90-1827) **Fire safety lessons learned from the design and operation of commercial nuclear reactor facilities.** Nowlen, S.P. Sandia National Labs., Albuquerque, NM (United States). Feb 1993. 95p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. Order Number DE93010609. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report summarizes the fire safety "lessons learned" that have resulted from the past 20 years of commercial nuclear power plant operations and 15 years of US Nuclear Regulatory Commission sponsored fire safety research. These insights are intended to provide guidance to the Department of Energy (DOE) in the selection of appropriate design, construction, and operational fire safety criteria for the plannedNew Production Reactor (NPR). The potential for fire-induced equipment damage has been consistently identified as an important core damage risk issue for commercial nuclear reactors. A significant knowledge base regarding many aspects of fire safety has been gained as a result of the commercial industry experience, research sponsored by the US Nuclear Regulatory Commission (USNRC) and from the results of fire risk assessments. However, for the commercial nuclear industry, the

implementation of fire safety provisions has been a long and difficult process. Much of this difficulty can be attributed to the fact that the USNRC's fire safety regulations were implemented as retrofit rules, which often required extensive and expensive plant modifications. Despite the improvements in the fire safety knowledge base, a number of fire safety issues remain unaddressed, are very poorly understood, and/or have not been addressed-by past fire risk assessments. For NPR it will be important to implement fire safety as a part of the plant design and construction. It is also clear that the regulations that apply to the current generation of commercial reactors will not represent an adequate design basis for new reactors. Anticipated changes in the nuclear industry fire safety requirements should be incorporated into the NPR design in order to ensure that NPR achieves a level of fire safety which both exceeds that of current reactor sites and which will continue to comply with future fire safety requirements.

23670 (SAND–92-2021) **An Integral Effects Test to investigate the effects of condensate levels of water and preexisting hydrogen on direct containment heating in the Surtsey Test Facility: The IET-7 experiment.** Allen, M.D. (Sandia National Labs., Albuquerque, NM (United States)); Blanchat, T.K.; Pilch, M.; Nichols, R.T. Sandia National Labs., Albuquerque, NM (United States). Jan 1993. 88p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. Order Number DE93007933. Source: OSTI; NTIS; INIS; GPO Dep.

This report discusses the seventh experiment of the Integral Effects Test (IET-7) series. The experiment was conducted to investigate the effects of preexisting hydrogen in the Surtsey vessel on direct containment heating. Scale models of the Zion reactor pressure vessel (RPV), cavity, instrument tunnel, and subcompartment structures were constructed in the Surtsey Test Facility at Sandia National Laboratories. The RPV was modeled with a melt generator that consisted of a steel pressure barrier, a cast MgO crucible, and a thin steel inner liner. The melt generator/crucible had a hemispherical bottom head containing a graphite limitor plate with a 4-cm exit hole to simulate the ablated hole in the RPV bottom head that would be formed by ejection of an instrument guide tube in a severe nuclear power plant accident. The cavity contained 3.48 kg of water, and the containment basement floor inside the cranewall contained 71 kg of water, which corresponds to scaled condensate levels in the Zion plant. A 43-kg initial charge of iron oxide/aluminum/chromium thermite was used to simulate corium debris on the bottom head of the RPV. Molten thermite was ejected by steam at an initial pressure of 5.9 MPa into the reactor cavity.

23671 (SAND–92-2538/1) **Heavy Water New Production Reactor design review guidelines: Volume 1, Main report: Final report.** Bergeron, K.D. (Sandia National Labs., Albuquerque, NM (United States)); Slezak, S.E.; Leach, C.E. Sandia National Labs., Albuquerque, NM (United States); Westinghouse Savannah River Co., Aiken, SC (United States). Feb 1993. 133p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. Order Number DE93012102. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The first step in Sandia National Laboratories' program to support the USDOE's Heavy Water New Production Reactor program in the area of severe accident prevention and mitigation was to perform a thorough review of all related technical information. This report is the product of that first step; it is a compendium of key information on core melt accidents written by nineteen specialists in a broad range of scientific and engineering fields. Topics covered include: In-Vessel Melt Progression; Molten Debris-Concrete Interactions; Fuel-Coolant Interactions; Hydrogen Combustion and Distribution; Mitigation Strategies; and Computer Simulation Codes and Accident Analysis. These reviews cover relevant work by specialists at Sandia as well as many other laboratories and institutes throughout the world. For each topic area, annotated bibliographies of key references are also provided. This document is Volume 1, the main report.

23672 (SAND–92-2538-Vol.2) **Heavy Water New Production Reactor design review guidelines: Volume 2, Appendices: Final report.** Bergeron, K.D. (Sandia National Labs., Albuquerque, NM (United States)); Slezak, S.E.; Leach, C.E. Sandia National Labs., Albuquerque, NM (United States); Westinghouse Savannah River Co., Aiken, SC (United States). Feb 1993. 786p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. Order Number DE93012080. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The first step in Sandia National Laboratories' program to support the USDOE's Heavy Water New Production Reactor program in the area of severe accident prevention and mitigation was to perform a thorough review of all related technical information. This report is the product of that first step; it is a compendium of key information on core melt accidents written by nineteen specialists in a broad range of scientific and engineering fields. Topics covered include: In-Vessel Melt Progression; Molten Debris-Concrete Interactions; Fuel-Coolant Interactions; Hydrogen Combustion and Distribution; Mitigation Strategies; andComputer Simulation Codes and Accident Analysis. These reviews cover relevant work by specialists at Sandia as well as many other laboratories and institutes throughout the world. For each topic area, annotatedbibliographies of key references are also provided. This document, Volume 2, contains appendices A-O of the main report.

23673 (SAND–93-0592C) **Containment bellows testing under extreme loads.** Splezter, B.L.; Lambert, L.D.; Parks, M.B. Sandia National Labs., Albuquerque, NM (United States). [1993]. 7p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-930803–6: 12. biennial conference for the International Association for Structural Mechanics in Reactor Technology, Stuttgart (Germany), 16-20 Aug 1993). Order Number DE93009848. Source: OSTI; NTIS; INIS; GPO Dep.

Sandia National Laboratories (SNL) is conducting several research programs to help develop validated methods for the prediction of the ultimate pressure capacity, at elevated temperatures, of light water reactor (LWR) containment structures. To help understand the ultimate pressure of the entire containment pressure boundary, each component must be evaluated. The containment pressure boundary consists of the containment shell and many access, piping, and electrical penetrations. The focus of the current research program is to study the ultimate behavior of flexible metal bellows that are used at piping penetrations. Bellows are commonly used at piping penetrations in steel containments; however, they have very few applications in concrete (reinforced or prestressed) containments. The purpose of piping bellows is to provide a soft connection between the containment shell and the pipe are attached while maintaining the containment pressure boundary. In this way, piping loads caused by differential movement between the piping and the containment shell are minimized. SNL is conducting a test program to determine the leaktight capacity of containment bellows when subjected to postulated severe accident conditions. If the test results indicate that containment bellows could be a possible failure mode of the containment pressure boundary, then methods will be developed to predict the deformation, pressure, and temperature conditions that would likely cause a bellows failure. Results from the test program would be used to validate the prediction methods. This paper provides a description of the use and design of bellows in containment piping penetrations, the types of possible bellows loadings during a severe accident, and an overview of the test program, including available test results at the time of writing.

23674 (SAND–93-0593C) **Separate effects testing to investigate liner tearing of the 1:6-scale reinforced concrete containment building.** Spletzer, B.L.; Lambert, L.D. Sandia National Labs., Albuquerque, NM (United States). [1993]. 5p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-930803–7: 12. biennial conference for the International Association for Structural Mechanics in Reactor Technology, Stuttgart (Germany), 16-20 Aug 1993). Order Number DE93009849. Source: OSTI; NTIS; INIS; GPO Dep.

The US Nuclear Regulatory Commission (NRC) is investigating the performance of containments subject to severe accidents. This work is being performed by Sandia National Laboratories (SNL). In 1987, a 1:6-scale Reinforced Concrete Containment (RCC) model was tested to failure. The failure mode was a liner tear. As a

result, a separate effects test program has been conducted to investigate liner tearing. This paper discusses the design of test specimens and the results of the testing. The post-test examination of the 1:6-scale RCC model revealed that the large tear was not an isolated event. Other small tears in similar locations were also discovered. All tears occurred near the insert-to-liner transition which is also the region of closest stud spacing. Also, all tears propagated vertically, in response to the hoop strain. Finally, all tears were adjacent to a row of studs. The tears point to a mechanism which could involve the liner/insert transition, the liner anchorage, and the material properties. The separate effects tests investigated these effects. The program included the design of three types of specimens with each simulating some features of the 1:6-scale RCC model. The specimens were instrumented using strain gages and photoelastic materials.

23675 (UCRL-ID–110822) **On seismic hazards/risk and power plant design.** Chung, D.H. Lawrence Livermore National Lab., CA (United States). May 1992. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE93009454. Source: OSTI; NTIS; INIS; GPO Dep.

The basic premise of probabilistic seismic hazard analysis (PSHA) is to calculate the probability of exceeding various levels of ground motions at a site of interest. We must assess (1) the possible sources of earthquakes that might affect ground motions at the site, (2) the maximum magnitude earthquakes that each source is capable of generating, (3) the recurrence rate of earthquakes of all magnitudes up to themaximum on each source; and (4) the attenuation of strong ground motions as a function of source to site distance and magnitude. These four basic elements in the PSHA methodologies have not changed significantly from C.A. Cornell's original work, but some specific details about individual steps involved in the PSHA applications have been improved over the last 20 years. What has changed dramatically in recent years has been our scientific ability to estimate those physical quantities in the PSHA elements above with more confidence and to quantify more appropriately the uncertainties associated with the input parameters of these basic elements.

23676 (UCRL-JC–110420) **On fire risk/methodology for the next generation of reactors and nuclear facilities.** Majumdar, K.C.; Alesso, H.P.; Altenbach, T.J. Lawrence Livermore National Lab., CA (United States). 15 Oct 1992. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9301102–1: American Nuclear Society (ANS) meeting, Clearwater, FL (United States), 27 Jan 1993). Order Number DE93011876. Source: OSTI; NTIS; INIS; GPO Dep.

Methodologies for including fire in probabilistic risk assessments (PRAs) have been evolving during the last ten years. Many of these studies show that fire risk constitutes a significant percentage of external events, as well as the total core damage frequency. This paper summarizes the methodologies used in the fire risk analysis of the next generation of reactors and existing DOE nuclear facilities. Methodologies used in other industries, as well as existing nuclear power plants, are also discussed. Results of fire risk studies for various nuclear plants and facilities are shown and compared.

23677 (UCRL-JC–111964) **Determining the controlling earthquake from probabilistic hazards for the proposed Appendix B.** Bernreuter, D.L. Lawrence Livermore National Lab., CA (United States). Oct 1992. 26p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-921007–26: 20. water reactor safety information meeting, Bethesda, MD (United States), 21-23 Oct 1992). Order Number DE93012491. Source: OSTI; NTIS; INIS; GPO Dep.

The new proposed Appendix B to 10CFR100 requires that both probabilistic and deterministic evaluations be made. The details of how to perform these evaluations are outlined in the proposed draft Regulatory Guide DG-1015. In DG-1015, one element of the probabilistic evaluation recommends determining the controlling earthquake from the probabilistic seismic hazard analysis (CE-PA). In this paper, the concept of the CEPA is discussed along with the approach that is suggested to determine the CE-PA. This paper reviews the basis for the various key choices that must be made. We also apply the approach to eight sites using the LLNL seismic hazard methodology developed for NRC.

23678 (WSRC-MS–91-531) **RELAP5/MOD3 code assessment with flow instability testing of an annular geometry fuel assembly.** Chen, K.F. Westinghouse Savannah River Co., Aiken, SC (United States). [1993]. 29p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. (CONF-930830–5: National conference and exposition on heat transfer, Atlanta, GA (United States), 8-11 Aug 1993). Order Number DE93007449. Source: OSTI; NTIS (US Sales Only); GPO Dep.

RELAP5/MOD3 was assessed with data obtained from flow excursion tests in an annular geometry test assembly to show that the code can model the thermal-hydraulic behavior of New Production Reactor-Heavy Water Reactor (NPR-HWR) fuel assemblies. The flow excursion tests were upflow tests conducted using an electrically heated full-scale model of a Savannah River Site (SRS) fuel assembly. Unpowered and powered steady-state tests, power ramp tests, and simulated loss of coolant accident tests were run. This assessment indicates that the single-phase thermal-hydraulic predictions of RELAP5/MOD3 agree with the measurements. RELAP5/MOD3 underestimates the power required for the onset of flow instability.

23679 (WSRC-MS–92-262) **Response of structures to energetic events for the Savannah River Site production reactors probabilistic risk assessment.** Santa Cruz, S.M. (Science Applications International Corp., Albuquerque, NM (United States)); Smith, D.C.; Yau, W.F. Westinghouse Savannah River Co., Aiken, SC (United States). [1992]. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. (CONF-930803–1: 12. biennial conference for the International Association for Structural Mechanics in Reactor Technology, Stuttgart (Germany), 16-20 Aug 1993). Order Number DE93001612. Source: OSTI; NTIS; INIS; GPO Dep.

The response of structures to energetic events postulated to arise in a probabilistic risk assessment (PRA) of a Savannah River Site (SRS) production reactor is addressed. Energetic events that arise in PRAs can damage structures and therefore have a significant influence on subsequent accident progression. Consequently, the structural response is important to the calculated risk of operating a plant. Difficulties are encountered, however, in the analysis of structural response of components to energetic loadings. First, the analysis of energetic events often does not provide well-defined static or dynamic loads acting on the structures. Secondly, risk assessments, by their nature, address a wide range of events that are not necessarily precisely defined. This paper describes an approach taken to develop the structural analysis required to support the PRA of the SRS production reactor, that overcomes these difficulties.

23680 (WSRC-MS–92-292) **Development of an Accident Management Program for the K-Reactor cooling tower at the Savannah River Site.** Simpkins, P.J.; Britt, T.E.; Lansaw, K.J. Westinghouse Savannah River Co., Aiken, SC (United States). [1992]. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. (CONF-930601–11: American Nuclear Society (ANS) annual meeting, San Diego, CA (United States), 20-24 Jun 1993). Order Number DE93009898. Source: OSTI; NTIS; INIS; GPO Dep.

This report discusses the Accident Management program at SRS has developed a new methodology for the safe operation of the K-Reactor. This methodology was recently applied during the loss of ultimate heat sink analysis which answers the question of which alternatives are present when the Reactor loses it primary cooling source. With the addition of a new cooling tower there is a need to reapply and perhaps modify the analysis to include the effects of the tower on the existing systems. This process combines the efforts of many different groups. Included in these efforts are interviews with operators, information from documents and drawings, data from computer codes, practice from in-plant drills, and efforts from multi-functional organizations. The central theme of this paper is the explanation of the task involved in the methodology and its application to the cooling tower addition.

23681 (WSRC-MS–92-365) **Nuclear reactor coolant spill as result of multichannel flow.** Steimke, J.L. Westinghouse Savannah River Co., Aiken, SC (United States). [1992]. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. (CONF-930830–15: National conference and exposition on heat transfer, Atlanta, GA (United States), 8-11 Aug 1993). Order Number DE93009876. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report discusses a leak of primary coolant which was detected as a nuclear production rector at the Savannah River Site (SRS) in South Carolina was approaching initial criticality. Control rods were being withdrawn when the leak detectors alarmed. The apparent location of the several gallon leak was where the control rods emerged from the top of the reactor. The reactor was shut down immediately. Control rods in SRS reactors are clustered in groups of seven and contained in a shell called a septifoil through which coolant flows. A new design of septifoil had been installed in a reator prior to the leak, a testing program was begun to installed in a reactor Prior to the leak. In response to the leak, a testing program was begun to determine the cause of the leak and to test methods for preventing future occurrences.

23682 (WSRC-MS–92-366) **Measurement of local void fraction in a ribbed annulus.** Steimke, J.L. Westinghouse Savannah River Co., Aiken, SC (United States). 22 Dec 1992. 20p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. (CONF-930830–9: National conference and exposition on heat transfer, Atlanta, GA (United States), 8-11 Aug 1993). Order Number DE93009808. Source: OSTI; NTIS; INIS; GPO Dep.

The computer code FLOWTRAN-TF is used to analyze hypothetical hydraulic accidents for the nuclear reactor at the Savannah River Site. During a hypothetical Large Break Loss-of-Coolant Accident (LOCA), reactor assemblies would contain a two-phase mixture of air and water which flows downward. Reactor assemblies consist of nested, ribbed annuli. Longitudinal ribs divide each annulus into four subchannels. For accident conditions, air and water can flow past ribs from one subchannel to another. For FLOWTRAN-TF to compute the size of those flows, it is necessary to know the local void fraction in the region of the rib. Measurements have previously been made of length-average void fraction in a ribbed annulus. However, no direct measurements were available of local void fraction. Due to the lack of data, a test was designed to measure local void fraction at the rib. One question addressed by the test was whether void fraction at the rib is solely a function of azimuthal-average void fraction or a function of additional variables such as pressure boundary conditions. This report provides a discussion of this test.

23683 (WSRC-MS–92-368) **Reverse flow through a large scale multichannel nozzle.** Duignan, M.R.; Nash, C.A. Westinghouse Savannah River Co., Aiken, SC (United States). [1992]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. (CONF-930830–10: National conference and exposition on heat transfer, Atlanta, GA (United States), 8-11 Aug 1993). Order Number DE93009809. Source: OSTI; NTIS; INIS; GPO Dep.

A database was developed for the flow of water through a scaled nozzle of a Savannah River Site reactor inlet plenum. The water flow in the nozzle was such that it ranged from stratified to water solid conditions. Data on the entry of air into the nozzle and plenum as a function of water flow are of interest in loss-of-coolant studies. The scaled nozzle was 44 cm long, had an entrance diameter of 95 mm, an exit opening of 58 mm x 356 mm, and an exit hydraulic diameter approximately equal to that of the inlet. Within the nozzle were three flow-straightening vanes which divided the flow path into four channels. All data were taken at steady-state and isothermal (300 K $\pm$ 1.5 K) conditions. During the reverse flow of water through the nozzle the point at which air begins to enter was predicted within 90% by a critical weir-flow calculation. The point of air entry into the plenum itself was found to be a function of flow conditions.

23684 (WSRC-MS–92-406) **Flow instability testing of annular geometry fuel elements for LOCA and slow ramp transient with upflow of coolant.** Smith, A.C. (Westinghouse Savannah River Co., Aiken, SC (United States)); Blake, J.E.; Childerson, M.T.; Ohrn, T.R.; Privette, R.M. Westinghouse Savannah River Co., Aiken, SC (United States). [1992]. 20p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. (CONF-930830–8: National conference and exposition on heat transfer, Atlanta, GA (United States), 8-11 Aug 1993). Order Number DE93008794. Source: OSTI; NTIS; GPO Dep.

This report discusses testing performed to provide data for evaluation and benchmarking of computer codes used for predicting the performance of reactor fuel elements of annular geometry with upward flow of coolant.

23685 (WSRC-RP–90-1338-Vol.1-Del.Ver.) **Analyses and evaluation of the cooling water reservoir and process effluent sump structures, Savannah River Site: Volume 1.** Bandyopadhyay, R.L. Westinghouse Savannah River Co., Aiken, SC (United States). Dec 1990. 194p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE93009744. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report describes the seismic analysis and evaluation of the Cooling Water Reservoir (CWR) structures.and the Process Effluent Sump (PES) building at the 100-K area of the Savannah River Site. The objective of this work was to evaluate the responses of the CWR and PES structures when subjected to the Design Basis Earthquake (DBE), which is described by the US Nuclear Regulatory commission's Regulatory Guide 1.60 horizontal spectrum shape anchored at 0.g zero period acceleration (ZPA). The vertical input is defined as 2/3 of the horizontal spectra through the entire frequency range of interest. The CWR and PES structures are part of the Cooling Water System (CWS) which is the primary system to remove residual heat from the reactor. Though the seismic analyses and structural evaluations were conducted specifically for the 100-K area CWR and PES structures, the results and conclusions also apply to the corresponding structures in the 100-L and 100-P areas. This is based on a parametric study and comparisons of the structures and available soil properties of the three areas as discussed in this report.

23686 (WSRC-RP–90-1338-Vol.2) **Analyses and evaluation of the cooling water reservoir and process effluent sump structures, Savannah River Site: Volume 2.** Bandyopadhyay, R.L. Westinghouse Savannah River Co., Aiken, SC (United States). Dec 1990. 259p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE93009882. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report describes the seismic analysis and evaluation of the cooling Water Reservoir (CWR) structures and the Process Effluent Sump (PES) building at the 100-K area of the Savannah River Site. The objective of this work was to evaluate the responses of the CWR and PES structures when subjected to the Design Basis Earthquake (DBE), which is described by the u.S. Nuclear Regulatory commission's Regulatory Guide 1.60 horizontal spectrum shape anchored at 0.209 zero period acceleration (ZPA). The vertical input is defined as 2/3 of the horizontal spectra through the entire frequency range of interest. The CWR and PES structures are part of the cooling Water System (CWS) which is the primary system to remove residual heat from the reactor. Though the seismic analyses and structural evaluation were conducted specifically for the 100-K area CWR and PES structures, the results and conclusions also apply to the corresponding structures in the 100-L and loop areas. This is based on a parametric study and comparisons of the structures (Section 1-3) and available soil properties of the three areas as discussed later in this report. This document, Volume 2, provides Appendix C of the report. This Appendix provides plots and digitized tables of floor acceleration response spectra.

23687 (WSRC-RP–92-653) **Numerical modeling of the expansion phase of steam explosions: Part 1, Method and validation.** Hyder, M.L. (Westinghouse Savannah River Co., Aiken, SC (United States)); Farawila, Y.M.; Abdel-Khalik, S.I.; Halvorson, P.J. Westinghouse Savannah River Co., Aiken, SC (United States). May 1992. 44p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE93013689. Source: OSTI; NTIS; INIS; GPO Dep.

In the development of the Severe Accident Analysis Program for the Savannah River production reactors, it was recognized that certain accidents have -the potential for causing damaging steam

explosions. Steam explosions can occur when metals, such as the aluminum-based fuel used at Savannah River, are melted and come into contact with water. This condition is unstable, and local turbulence can lead to the generation of great quantities of steam within a few milliseconds. This phenomenon has been observed in several reactor incidents and experiments (BORAX, SPERT-1, SL-1, probably Chernobyl) where it caused damage to the reactor and associated structures. The massive SRS reactor buildings are likely to withstand any imaginable steam explosion. However, reactor components and building structures including hatches, ventilation ducts, etc., could be at risk if such an explosion occurred. The goal for this study was to develop a computer code that could be used parametrically to predict the effects of various steam explosions on their surroundings. This would be able to predict whether a steam explosion of a given magnitude would be likely to fail a particular structure. This would require, of course, that the magnitude of the explosion be specified through some combination of judgment and calculation. The requested code, identified as the K-FIX(GT) code, was developed and delivered by the contractor, along with extensive documentation. The several individual reports that constitute the documentation are each being issued as a separate WSRC report. Documentation includes several model calculations, and. representation of these in graphic form. This report incorporates Report GTRSR-006, which gives an overview of the methods used in the development of K-FIX(GT), and the results of a comparison with experiments in the literature. The authors conclude that the results of the comparison calculation are in reasonable agreement with observations.

24 POWER TRANSMISSION AND DISTRIBUTION

2401 Power Systems

Refer also to citation(s) 23769

2402 Power System Networks, Transmission and Distribution

Refer also to citation(s) 23229, 23235, 24552

2404 Health and Safety

Refer also to citation(s) 24925

23688 (CONF-921275–, pp. 137-138) **Estimation on ventricular fibrillation current at high-frequency electric shocks.** Yamano, E. (Research Institute of Industrial Safety, Tokyo (Japan)). 2 Dec 1992. 160p. (In Japanese). From 25. safety engineering study meeting; Kitakyushu (Japan); 2-3 Dec 1992. In *Proceedings of the 25th Safety Engineering Study Meeting*. Order Number DE93793904. Source: OSTI; NTIS (US Sales Only).

Data have been accumulated extensively on threshold currents in ventricular fibrillation, a major cause of sudden death from electric shocks, in a range of utility frequencies, but data with high frequencies are not available sufficiently. This paper gives a consideration on one method to estimate ventricular fibrillation currents at frequencies exceeding 1 kHz. For the sensing current, the threshold current I_t increases with increasing frequency 'f'. While the increase begins with a small slope, a slope in the I_t-f curve in a range from 30 kHz to 100 kHz on a log-log section paper is from about 0.9 to 1.2 which remains approximately constant. Such an I_t-f curve may be approximated largely with a parallel circuit consisting of C and R. For the frequency dependence of the ventricular fibrillation, when a large number of data on animals and human beings are put in order, a threshold value may be established that is smaller (safer) than that from nearly all of the data if the time constant is set to CR = 0.7 ms, for example. 3 refs., 2 figs.

25 ENERGY STORAGE

Refer also to citation(s) 23780

23689 (UCRL-ID–111412) **Electromechanical batteries and the electric utilities: An estimate of the potential market for high-strength fibers.** Post, R.F. Lawrence Livermore National Lab., CA (United States). 11 Aug 1992. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE93013307. Source: OSTI; NTIS; GPO Dep.

This technical note presents an estimate of the market for high-strength fibers that could arise, based on the adoption of modular electromechanical batteries by the US electric utilities to satisfy their needs for distributed energy storage for load-leveling and energy reserves. It is shown that this market alone would involve a requirement for such fibers (from which to construct the rotors of the E-M batteries) involving many billions of dollars per year of sales. Counting in foreign markets, and other likely uses of the E-M battery in commercial and industrial settings, the demands would far exceed present-day world-wide production levels of the candidate fibers.

2501 Magnetic

Refer also to citation(s) 23867

2502 Compressed and Liquefied Gas

Refer also to citation(s) 23867

2505 Flywheels

Refer also to citation(s) 23867

2506 Thermal

Refer also to citation(s) 23292

23690 (CONF-921276–, pp. 151-154) **Study on a temperature selective heat storage tank. Part 4.: Extraction of discharged cold and hot water.** Kamiya, Y. (Kanto Gakuin University, Yokohama (Japan)); Kurihara, S. 3 Dec 1992. 305p. (In Japanese). From 1992 Japan Solar Energy Society, Japan Wind Energy Association joint converence; Osaka (Japan); 3-4 Dec 1992. In *1992 JSES (Japan Solar Energy Society)/JWEA (Japan Wind Energy Association) Joint Conference*. Order Number DE93793955. Source: OSTI; NTIS (US Sales Only).

Investigation was made on a method in which discharged cold and hot water was temperature-selectively extracted from the temperature-selective heat storage tank without using control machinery at all. System adopted into the present investigation was to newly install the other damper-equipped extracting sub-tank than the conventional sub-tank and open/close the dampers with enforcement with Ni-Ti shape memory metal (NT). In the hot water extracting damper-opening/closing device, the dampers are opened/closed by a rod fitted at the end of shaft which moves from side to side upon fluctuation in NT spring constant following that in temperature. The dampers can be opened/closed at 35 to 45 centigrade and 10 centigrade in temperature by the damper-opening/closing device. As a result of experiment, extraction could be made of discharged hot and cold water which was lower than 40 centigrade nd about 12 centigrade, respectively in temperature. Both 35 centigrade and 15 centigrade layers were temperature-selectively taken out for the simultaneous hot and cold water extraction. The fitting angle of damper-opening/closing device is judged optimizable in value depending upon the utilization hours and thermal loss. 4 refs., 9 figs., 1 tab.

23691 (CONF-921276–, pp. 171-174) **Three-dimensional simulation of borehole seasonal energy system for the high-story building.** Saito, T. (Tohoku University, Sendai (Japan). Faculty of Engineering); Shinomiya, J. 3 Dec 1992. 305p. (In Japanese). From 1992 Japan Solar Energy Society, Japan Wind Energy Association joint converence; Osaka (Japan); 3-4 Dec 1992. In *1992 JSES (Japan Solar Energy Society)/JWEA (Japan*

Wind Energy Association) Joint Conference. Order Number DE93793955. Source: OSTI; NTIS (US Sales Only).

This paper proposes and simulates an air conditioning system for a high-story building using borehole heat storage process to suppress urban warming. Twenty-five vertical pipes drilled into ground to a depth of 100 m were used as one unit. Waste heat from a room cooling system and solar heat are stored in the borehole during summer, and are recovered from the boreholes to be used as a source for room heating and hot water supply. Solar cells are installed on half the area of the south wall to generate electric power. A three-dimensional analysis was performed on the units to clarify the heat storing and dissipating processes. A three-dimensional analysis was conducted to elucidate seasonal heat storing characteristics in soil temperatures of the borehole heat storing system. Use of 30 borehole units each with 12 m x 12 m was suitable for a 36-story building with three basements and a total floor area of 150,000 m^2. The system discharges no heat into the atmosphere, but stores heat in the soil to prevent urban warming. This system that utilizes solar energy and borehole heat storage reduces the energy consumption and CO2 emission by about 50% compared with conventional heat-pump room cooling and boiler room heating using air as the heat source. 11 refs., 9 figs., 5 tabs.

2508 Chemical

23692 (CONF-921276–, pp. 159-162) **Transmittance of working fluid (water and salt-water solution) for solar pond.** Kanayama, K. (Kitami Institute of Technology, Hokkaido (Japan)); Endo, N.; Baba, H.; Yanagida, E. 3 Dec 1992. 305p. (In Japanese). From 1992 Japan Solar Energy Society, Japan Wind Energy Association joint converence; Osaka (Japan); 3-4 Dec 1992. In *1992 JSES (Japan Solar Energy Society)/JWEA (Japan Wind Energy Association) Joint Conference.* Order Number DE93793955. Source: OSTI; NTIS (US Sales Only).

Water and salt water were measured in spectral transmittance by a spectral radiometer in order to support the performance measurement of solar saline pond. Investigation based on the molecular vibration being applied to the absorption band which appeared in the transmission spectrum of water, the total transmittance was calculated down to a water depth of 3m in the pond upon deducing the reason for which the spectral transmittance per the above spectrum heightened with heightening in salt concentration. The water gradually becomes an opaque body in spectral transmittance with lengthening in wave from the visible wave wavelength region (more than 0.6μm in wavelength) to the near infrared and infrared regions, through which absorption bands appear one after another. Such a phenomenon is attributable to the absorption bands of harmonic overtone due to the O-H-deformed vibration of water. Influenced also by the concentration in the visible wave wavelength, near infrared and infrared regions, the spectral transmittance of salt water heightens with heightening in concentration. Such a heightening in transmissibility is attributable to the dissolution of bipolar molecules of the water in the form of being taken in by Na^+ and Cl^-, which therefore controls the O-H-stretched vibration of water. As a result, the water and salt water could be obtained in total transmittance down to a water depth of 3m in the pond. 17 refs., 7 figs.

23693 (UCRL-JC–112177) **Effects of aqueous solution compositions on Aerocapacitor energy density.** Mayer, S.T.; Kaschmitter, J.L.; Pekala, R.W. Lawrence Livermore National Lab., CA (United States). 4 Nov 1992. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-930571–12: 183. Electrochemical Society meeting, Honolulu, HI (United States), 16-21 May 1993). Order Number DE93013431. Source: OSTI; NTIS; GPO Dep.

The Aerocapacitor is an electrochemical double-layer energy-storage device that utilizes carbon aerogels as electrodes. In this paper, the effect of 1M electrolyte composition on the Aerocapacitor's average-integral (AIC) and differential capacitance is investigated. The AIC values range from 7.2 to 22.5 F/cc for the electrode formulation used in this study. Typically, the AIC increase by a factor of two, and the differential capacitance by a factor of four, between 0 and 1.2 V.

2509 Batteries

Refer also to citation(s) 23189, 23246, 23689, 23754, 23868

23694 (ANL/CMT/CP–79338) **Battery testing at Argonne National Laboratory.** DeLuca, W.H.; Gillie, K.R.; Kulaga, J.E.; Smaga, J.A.; Tummillo, A.F.; Webster, C.E. Argonne National Lab., IL (United States). 25 Mar 1993. 23p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-9303137–1: Interagency Advanced Power Group (IAPG) chemical working group meeting, White Oak, MD (United States), 25 Mar 1993). Order Number DE93011761. Source: OSTI; NTIS; GPO Dep.

Argonne National Laboratory's Analysis & Diagnostic Laboratory (ADL) tests advanced batteries under simulated electric and hybrid vehicle operating conditions. The ADL facilities also include a post-test analysis laboratory to determine, in a protected atmosphere if needed, component compositional changes and failure mechanisms. The ADL provides a common basis for battery performance characterization and life evaluations with unbiased application of tests and analyses. The battery evaluations and post-test examinations help identify factors that limit system performance and life, and the most-promising R&D approaches for overcoming these limitations. Since 1991, performance characterizations and/or life evaluations have been conducted on eight battery technologies (Na/S, Li/S, Zn/Br, Ni/MH, Ni/Zn, Ni/Cd, Ni/Fe, and lead-acid). These evaluations were performed for the Department of Energy's. Office of Transportation Technologies, Electric and Hybrid Propulsion Division (DOE/OTT/EHP), and Electric Power Research Institute (EPRI) Transportation Program. The results obtained are discussed.

23695 (CONF-921275–, pp. 133-134) **Heat generating behavior of lithium batteries using ARC.** Okawa, S. (Mitsubishi Petrochemical Co.Ltd., Tokyo (Japan)); Arakawa, Y.; Hasegawa, K. 2 Dec 1992. 160p. (In Japanese). From 25. safety engineering study meeting; Kitakyushu (Japan); 2-3 Dec 1992. In *Proceedings of the 25th Safety Engineering Study Meeting.* Order Number DE93793904. Source: OSTI; NTIS (US Sales Only).

Heat related troubles occurred in 1989 in lithium batteries used in electronic devices, of which cause was attributed to internal short circuits due to defects in manufacturing processes. Heat generation should have been another cause that occurred from solute of the electrolyte which was lithium perchlorate and developed strong oxidative reaction. Since then, lithium trifluoromethane sulfonate that is considered weaker in reactivity has been used. Accordingly, this paper describes a discussion on heat generating behaviors of these two electrolytes from the safety viewpoint, using an ARC which is suitable for measuring spontaneous heat generation under a heat insulated condition. The result may be summarized as follows: Under presence of an electrode, the electrolyte and its organic solvent generated too much heat to be disregarded; the heat generation starting temperature shifted to lower side, a risk increasing direction; and the electrolyte solvent alone could have a risk of heat generation as a result of reacting with the electrode, but the risk would increase with LiClO4 and decrease with LiCF3SO3 conversely. 2 figs., 1 tab.

23696 (NEI-DK–1177) **Thin solid electrolytes on reactive anodes: Final report.** Mogensen, M. Risoe National Lab., Roskilde (Denmark). Materials Dept. Jan 1993. 105p. (In Danish). Contract EM-1443/86-1;Contract EM-1443/87-1. Order Number DE93794743. Source: OSTI; NTIS.

EFP-86; EFP-87.

A short summary of the results of research work carried out at Risoe National Laboratory related to the thin solid electrolytes which are formed on reactive anodes followed by nine appendices comprising the scientific publications produced in this relation, a collection of data and a popular article on the results. The aim of this research was to provide a general description of solid electrolytes which are spontaneously formed on lithium anodes when they are exposed to floating cathodes such as $SOCl_2$. The methods used for characterization were impedance spectroscopy and scanning electron microscopy. It was found that the most important parameter was the relation between the electron and the lithium ion conducting property. and that this could be determined by the

measurements taken. It was found that when lithium is exposed to $SOCl_2$, within a fraction of a second a thick primary layer of LiCl film is formed. This is filled with a number of impurities and appears to have a conducting property which causes a slow self-discharging of the anode in the beginning while the dissolved LiCl is formed in the catholyte. After this the LiCl begins to precipitate as whole pure LiCl crystals (the secondary LiCl layer). This reduces the speed of the self-discharge but finally chokes the battery because the inner resistance becomes too great. It was shown that the speed of growth can be controlled in the beginning (for a number of years) but finally the anode becomes passive. It is concluded that it is the formation and growth of the secondary layer of LiCl which determines the Li-$SOCl_2$ battery's service life. (AB) (24 refs.).

23697 (UCRL-JC–109422) **Feasibility assessment of electromechanical batteries for electric vehicles.** Comfort, W.J.; Bumpas, S.E.; Edmunds, T.A.; Hall, A.R.; Lamont, A.D.; McCue, H.K.; Zywicz, E. Lawrence Livermore National Lab., CA (United States). Feb 1992. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9206335–4: International symposium on automotive technology and automation, Florence (Italy), 1-5 Jun 1992). Order Number DE93013083. Source: OSTI; NTIS; GPO Dep.

The authors have assessed the current feasibility of substituting multi-shell composite flywheel motor-generators (electromechanical batteries) for electrochemical batteries in electric vehicles. We present two conceptual designs using the latest materials and technology. Feasibility was evaluated in terms of performance predictions based upon consistent and optimistic analytical models of components of these conceptual designs. The most challenging issues are capital cost and energy storage performance. Energy storage per unit cost favors the electrochemical battery. The power density, specific power, efficiency, and turn-around efficiency can be higher for the electromechanical battery than for projected electrochemical batteries of the future. We conclude that for electric vehicles, electromechanical batteries may be best suited for a hybrid application with electrochemical batteries. This combines the high specific power, power density, and turn-around efficiency possible with the electromechanical battery and the low cost of the electrochemical battery.

29 ENERGY PLANNING AND POLICY

23698 (ANL/ESD/TM–45) **Governmental structure of the Russian Federation with respect to environmental and energy programs.** Colangelo, R.V. (Environmental Planning Group, Inc., Elk Grove Village, IL (United States)); Reistroffer, E.L.; Edgar, D.E. Argonne National Lab., IL (United States). Energy Systems Div. Sep 1992. 61p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. Order Number DE93013499. Source: OSTI; NTIS; GPO Dep.

An investigation was conducted by the Environmental Planning Group, Inc., to provide an overview of the structure of government environmental and energy programs in the Russian Federation. The investigation was undertaken to provide a baseline of information to the US Department of Energy (DOE), so that technologies applicable to DOE environmental restoration and monitoring programs can be identified, tested, and transferred. Data for the report were collected through a network of Russian and American sources knowledgeable about environmental and energy programs in the Russian Federation. Sources of information included both US and Russian government personnel, nongovernmental organizations, private consultants, and experts from the academic and scientific communities. The peculiarities of the Union of Soviet Socialist Republics (USSR) remain prevalent in the structure of the Newly Independent States, especially in Russia. The legacy of communism is visible in all aspects of society, most particularly in the extreme environmental degradation that has resulted from careless central planning and policies of forced industrialization. Reforms initiated under Mikhail Gorbachev during the period of Perestroika were aimed at shifting power from the party to the respective government organs. In 1992 the Commonwealth of Independent States was created, joining 11 of the 15 republics into a loose federation. The investigation undertaken by the Environmental Planning Group, Inc., focused on the executive organs of the present Russian government in an effort to define key ministries with environmental and energy responsibilities. The structure of the Ministry of Ecology and Natural Resources (Minpriroda) and the Ministry of Atomic Power (Minatom) are presented. The Academy of Sciences and other ministries that have relevance to the transfer of technologies are discussed, as well as research institutions in which technologies appropriate to DOE programs are likely to reside.

23699 (DOE–76-45/6-Rev.1) **Training as related to behavioral change: Revision 1.** Nertney, R.J.; Buys, J.R. EG and G Idaho, Inc., Idaho Falls, ID (United States). System Safety Development Center. Jan 1993. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-76ID01570. (SSDC–6-Rev.1). Order Number DE93013700. Source: OSTI; NTIS; GPO Dep.

This guide provides a basis for upgrading safety training programs and is based on the MORT philosophy of systemic upgrade and repair. It attempts to change the old reactive approach to accidents and events: "If we tell or train people one more time, it won't happen again and everything will be all right." The ultimate objective of training programs is to change behavior of people. Many factors beyond our control influence human behavior on the job. Training elements must not be considered out of context. Behavioral changes may not occur due to emotional physiological sociological environmental, or managerial reasons. Once dominant factors have been identified it is possible to recognize problems and make effective changes. Training will ordinarily provide an effective solution to a behavioral problem only if the following conditions are met: Skill deficiencies are involved; performance is LTA now and has been in the past. It is possible to reach the desired optimum safety only if these conditions are met: Training is specifically targeted on priority safety problems; Safety problems are sensitive to training; Elements of training programs are coherent and mutually consistent; Training programs are consistent with communications to the trainees from other sources; Desired behavioral changes are logically related to existing individual and organizational attitudes. Efforts to alter human stereotype behavior will likely result in high error frequencies. The old behavior is likely to recur under stressful conditions.

23700 (DOE/AD–0009) **Disaster Recovery Program guideline.** USDOE Office of Administration and Human Resource Management, Washington, DC (United States). Office of Information Resources Management Policy, Plans, and Oversight. Jul 1991. 207p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93011822. Source: OSTI; NTIS; GPO Dep.

Business and government are dependent upon automatic data processing (ADP) to perform their missions and cannot afford to be without total, or possibly even partial, ADP capability for extended periods of time. The dependency on ADP and the large capital investment organizations are making in ADP equipment and services make implementation of a Disaster Recovery Program, with associated Continuity of Operations and Contingency Plans, essential based on a risk assessment. An effective Disaster Recovery Program can mitigate the losses from a disaster, reduce the amount of time that a customer or user is without mission-essential ADP support, and decrease the time necessary for restoration of normal ADP operations.

23701 (DOE/CE/90053–T44) **[Interagency Advanced Power Group Steering Group meeting minutes].** Hanst, J.W. Horizon Data Corp., Reston, VA (United States). Power Information Center. 21 May 1993. 24p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC01-90CE90053. Order Number DE93013702. Source: OSTI; NTIS; GPO Dep.

Subjects presented in this report include working group and panel reports, PIC status report, old business, new business, and IAPG policies and procedures. (JDB)

23702 (DOE/EIA–0437(91)/2) **Financial statistics of major publicly owned electric utilities, 1991.** USDOE Energy Information Administration, Washington, DC (United States). Office of Coal, Nuclear, Electric and Alternate Fuels. 31 Mar 1993. 427p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93011468. Source: OSTI; NTIS; INIS; GPO Dep.

The Financial Statistics of Major Publicly Owned Electric Utilities publication presents summary and detailed financial accounting data on the publicly owned electric utilities. The objective of the publication is to provide Federal and State governments, industry, and the general public with data that can be used for policymaking and decisionmaking purposes relating to publicly owned electric utility issues.

23703 (DOE-STD–1021-93) **Natural phenomena hazards performance categorization guidelines for structures, systems, and components.** USDOE, Washington, DC (United States). Jul 1993. 5p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93015087. Source: OSTI; NTIS; GPO Dep.

The Department of Energy (DOE) requires in DOE 5480.23 the use of a "graded approach" in performing safety analysis and evaluation of DOE facilities for normal operating and accident conditions, including accidents caused by natural phenomena hazard (NPH) events. DOE 5480.28 uses this graded approach and requires, for the purpose of NPH design and evaluation, placing the structures, systems, and components (SSCs) comprising the DOE facilities into five performance categories. This standard is a revision to DOE-STD-1021-92, December 1992, and provides guidelines to be used for such categorization of SSCs, and recommends systematic procedures to implement these guidelines. It applies to all DOE facilities that are covered by DOE 5480.28. (JDB)

23704 (DOE-STD–1031-92) **Guide to good practices for communications.** USDOE, Washington, DC (United States). Dec 1992. 23p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93014732. Source: OSTI; NTIS; GPO Dep.

The purpose of this Guide to Good Practices is to provide Department of Energy (DOE) contractors with information that can be used to validate and/or modify existing programs relative to Conduct of Operations. This Guide to Good Practices is part of a series of guides designed to enhance the guidelines set forth in DOE Order 5480.19, "Conduct of Operations Requirements for DOE Facilities."

23705 (DOE-STD–1032-92) **Guide to good practices for operations organization and administration.** USDOE, Washington, DC (United States). Dec 1992. 23p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93014733. Source: OSTI; NTIS; GPO Dep.

The purpose of this Guide to Good Practices is to provide Department of Energy (DOE) contractors with information that can be used to validate and/or modify existing programs relative to Conduct of Operations. This Guide to Good Practices is part of a series of guides designed to enhance the guidelines set forth in DOE Order 5480.19, "Conduct of Operations Requirements for DOE Facilities."

23706 (DOE-STD–1033-92) **Guide to good practices for operations and administration updates through required reading.** USDOE, Washington, DC (United States). Dec 1992. 35p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93014817. Source: OSTI; NTIS; GPO Dep.

The purpose of this Guide to Good Practices is to provide Department of Energy (DOE) contractors with information that can be used to validate and/or modify existing programs relative to Conduct of Operations. This Guide to Good Practices is part of a series of guides designed to enhance the guidelines set forth in DOE Order 5480. 19, "Conduct of Operations Requirements for DOE Facilities." (JDB)

23707 (DOE-STD–1034-93) **Guide to good practices for timely orders to operators.** USDOE, Washington, DC (United States). Mar 1993. 27p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93014734. Source: OSTI; NTIS; GPO Dep.

The purpose of this Guide to Good Practices is to provide Department of Energy (DOE) contractors with information that can be used to validate and/or modify existing programs relative to Conduct of Operations. This Guide to Good Practices is part of a series of guides designed to enhance the guidelines set forth in DOE Order 5480. 19, "Conduct of Operations Requirements for DOE Facilities." (JDB)

23708 (DOE-STD–1035-93) **Guide to good practices for logkeeping.** USDOE, Washington, DC (United States). Mar 1993. 31p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93014735. Source: OSTI; NTIS; GPO Dep.

The purpose of this Guide to Good Practices is to provide Department of Energy (DOE) contractors with information that can be used to validate and/or modify existing programs relative to Conduct of Operations. This Guide to Good Practices is part of a series of guides designed to enhance the guidelines set forth in DOE Order 5480. 19, "Conduct of Operations Requirement for DOE Facilities." (JDB)

23709 (DOE-STD–1039-93) **Guide to good practices for control of equipment and system status.** USDOE, Washington, DC (United States). Mar 1993. 17p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93014736. Source: OSTI; NTIS; GPO Dep.

The purpose of the Guide to Good Practices is to provide Department of Energy (DOE) contractors with information that can be used to validate and/or modify existing programs relative to Conduct of Operations. This Guide to Good Practices is part of a series of guides designed to enhance the guidelines set forth in DOE Order 5480. 19, "Conduct of Operations Requirements for DOE Facilities."(JDB)

23710 (DOE-STD–1056-93) **Guide to good practices for line and training manager activities related to training.** USDOE, Washington, DC (United States). Feb 1993. 30p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93012878. Source: OSTI; NTIS; GPO Dep.

Training provides personnel with the knowledge and skills necessary to perform their jobs safely, effectively, and efficiently with minimal supervision. Excellence in training and qualification is particularly important in the industry where adherence to proper work practices and procedures is essential to public health and safety. To achieve this, facility personnel should be fully involved and accountable for their contribution to the success of their facility. Line and training managers share the responsibility of ensuring that all training programs are effective. Periodic observation of training and qualification programs by line managers is essential to this effort. These line managers include appropriate levels of involvement by the reactor or nuclear facility manager, the plant manager, the line manager, and others in the line organization as needed. Interest in personnel training and qualification by senior management, including an occasional visit to the training classroom, laboratory, simulator, or on-the-job should be used to reinforce the importance of training, qualification, and line manager involvement. Communications between line and training managers will aid in establishing the relationship necessary between the facility and training organization to achieve the training goals.

23711 (DOE-STD–1057-93) **Guide to good practices for the selection, training, and qualification of shift technical advisors.** USDOE, Washington, DC (United States). Feb 1993. 79p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93012980. Source: OSTI; NTIS; GPO Dep.

The DOE Guide to Good Practices For The Selection, Training, and Qualification of Shift Technical Advisors can be used by any DOE nuclear facility that has implemented the shift technical advisor position. DOE Order 5480-20, "Personnel Selection, Qualification, Training, and Staffing Requirements at DOE Reactor and Non-Reactor Nuclear Facilities," states that only Category A reactors must use shift technical advisor position. However, many DOE nuclear facilities have implemented the shift technical advisor position to provide independent on-shift technical advice and counsel to the shift operating personnel to help determine cause and mitigation of facility accidents. Those DOE nuclear facilities that have implemented or are going to implement the shift technical advisor position will find this guide useful. This guide addresses areas that may be covered by other training programs. In these cases, it is unnecessary (and undesirable) to duplicate these areas in the STA training program as long as the specific skills and knowledge essential for STAs are addressed. The guide is presented based on the premise that the trainee has not completed any facility-specific training other than general employee training.

23712 (DOE-STD–1058-93) **Guide to good practices for developing and conducting case studies.** USDOE, Washington, DC (United States). Feb 1993. 44p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93012982. Source: OSTI; NTIS; GPO Dep.

Learning from experience is often very costly to a facility: in terms of injured personnel, damaged equipment, and wasted manhours. Learning from the experience gained at the facility and from industry can prevent repeating costly mistakes. This guide contains a method for teaming from experience to prevent mistakes from occurring. That method is the case study. This guide describes how to develop and present case studies. This guide should give the instructional developer some ideas on the best kind of case study to use as well as providing examples of the various types of case studies. Training on industry and inhouse operating experiences should occur throughout the training program to help prevent recurring unsafe events and to curb dangerous trends. Experiences from the facility or from other industries should be incorporated in a manner that is systematic and timely in conveying useful information. Case studies provide a means to organize this information and present it to the trainees in a systematic way. By having trainees analyze and discuss case studies, the Teaming experience is accelerated because the trainees are actively involved in the learning process.

23713 (DOE-STD–1059-93) **Guide to good practices for maintenance supervisor selection and development.** USDOE, Washington, DC (United States). Feb 1993. 54p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93012981. Source: OSTI; NTIS; GPO Dep.

This guide has been developed based on functional responsibilities typical of the electrical, mechanical, instrument, and control, maintenance supervisor positions. This guide applies to all levels of maintenance supervision, up to but not including the maintenance manager. The following are included in these guidelines: An assessment and selection process for supervisor candidates; An outline for an initial supervisory training program for the selected candidates to enhance their current skills; An outline for a continuing training program to maintain and improve the abilities of supervisors. Incumbent supervisors should be trained on selected subjects of these guidelines, based on identified needs. When selecting personnel for assignment to the maintenance supervisor position, facility management should compare the candidates' demonstrated leadership, work standards, and analytical abilities, as well as experience, past performance, education, training, and knowledge of the facility, as they relate to the responsibilities of the position. Facility line-managers should select those individuals who have the potential to demonstrate high qualities of leadership, supervision, judgment, motivation, integrity, and professionalism demanded of supervisors within the Department of Energy (DOE) community.

23714 (DOE-STD–1060-93) **Guide to good practices for continuing training.** USDOE, Washington, DC (United States). Feb 1993. 23p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93012979. Source: OSTI; NTIS; GPO Dep.

The purpose of this Guide to Good Practices for Continuing Training is to provide contractor training organizations with information and methods useful in the development and implementation of a continuing training program. DOE Order 5480.18A, "Accreditation of Performance-Based Training for Category A Reactors and Nuclear Facilities," and DOE Order 5480.20, "Personnel Selection, Qualification and Training Requirements at DOE Reactor and Nonreactor Nuclear Facilities" Chapter 1, Paragraph 7, require each facility to design and implement a continuing training program. Continuing training is necessary to ensure that facility personnel continually improve their ability to operate and maintain their facility in a safe and reliable manner. Continuing training also should enhance the professionalism of these individuals and should make them aware of the possible consequences of misoperation.

23715 (DOE-STD–1061-93) **Guide to good practices for the selection, training, and qualification of shift supervisors.** USDOE, Washington, DC (United States). Feb 1993. 92p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93013954. Source: OSTI; NTIS; GPO Dep.

The purpose of the Department of Energy (DOE) Guide to Good Practices for Selection, Training, and Qualification of Shift Supervisors is to provide DOE contractor organizations with information that can be used to modify existing programs or to develop new programs. DOE contractors should not feel obligated to adopt all parts of this guide. Rather, they can use the information in this guide to develop programs that apply to their facility.

2901 Energy Analysis and Modeling

Refer also to citation(s) 23767, 23772

23716 (DOE/PE/79065–T1) **The National Energy Modeling System: [Final report].** National Academy of Sciences - National Research Council, Washington, DC (United States). 1992. 152p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC01-90PE79065. Order Number DE93005123. Source: OSTI; NTIS; INIS; GPO Dep.

In response to a request from the US Department of Energy (DOE), in the summer of 1990 the National Research Council (NRC) established the Committee on the National Energy Modeling System (NEMS) to advise DOE and the Energy Information Administration (EIA) on the development and application of a modeling system to support energy policy analysis and strategic planning. As discussed later, this system should have the capability to simulate the effects of various energy policies on US energy supply and demand including economic, environmental and national security impacts. In this report, the committee offers its findings and recommendations on the process of developing a NEMS, the architecture and data needs of the system, and the organizational and management actions that will, in the committee's opinion, help make the system work.

23717 (ETDE-mf–93792574) **System studies on rational energy supply and use of mineralized carbon in the Merseburg region. Final report.** Hebecker, D.; Michalek, K. Technische Hochschule Leuna-Merseburg, Merseburg (Germany). Inst. fuer Technische Thermodynamik und Energiewirtschaft; Bundesministerium fuer Forschung und Technologie, Bonn (Germany). Dec 1991. 42p. (In German). Contract BMFT 13TA0394. Order Number DE93792574. Source: OSTI; NTIS (US Sales Only).

The task consisted of studies in order to continue the exploitation of the salt coal open cut mine Merseburg-Ost and recently to open cast working in Roeglitz in connection with a centralized energy conversation and power-industrial conclusions for the territory of Merseburg. Existing technological variants for the use of salt coal was evaluated. The possible energy concept for the territory of Merseburg was estimated on the basis of existing data and discussions of specialists. The interconnection of energy concept and use of salt coal was investigated with respect to the power-industrial conclusions and options. Under the present conditions the use of salt coal was evaluated as unfavourable, but it is a possible task for the future. (orig.) With 8 refs., 2 tabs., 7 figs.

2902 Economics and Sociology

Refer also to citation(s) 22909, 23730, 23736, 23740, 23749, 23770, 23771, 24740, 24859, 25299

23718 (DOE/NV/10845–T8) **A gabled wooden lodge in an archaeological context: Archaeological investigations at sample unit U19adPL, Nevada Test Site, Nye County, Nevada.** DuBarton, A.; Drollinger, H.; Edwards, S.; Hemphill, M.; Hockett, B.S.; Johnson, W.G.; King, C.; Beck, C.M.; Pippin, L.C. Nevada Univ., Reno, NV (United States). Quaternary Sciences Center. Dec 1992. 97p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC08-90NV10845. Order Number DE93013965. Source: OSTI; NTIS; GPO Dep.

In 1991 the Quaternary Sciences Center at the Desert Research Institute (DRI) conducted archaeological investigations at sample unit U19adPL on Pahute Mesa at the request of the Department of Energy, Nevada Field Office. This work was conducted under the

Long Range Study Plan, a data recovery program designed to intensively study an 11 percent geographic sample of the cultural resources on Pahute and Rainier mesas. The focus of the research was site 26NY3393. This site consists of a gabled wooden lodge with a hearth, a rock ring, and a dim use artifacts scatter of ceramics, lithic tools, and lithic debitage. The structure is the only gabled log structure known on Pahute and Rainier mesas, and associated artifacts included shell and glass beads. Based on temporally diagnostic artifacts, the occupation of site 26NY3393 spans 8000 years. There is no evidence that the site was occupied continuously for any great length of time. It is more likely that Native Americans inhabited the area intermittently on a seasonal basis. The gabled wooden lodge is a late construction, probably dating between A.D. 1760 and 1865. This report documents and presents the results of the archaeological work at sample unit U19adPL.

23719 (ETDE/JP-mf–93793770) **EC unification in confusion and the direction of the European energy market.** Institute of Energy Economics, Tokyo (Japan). 17 Nov 1992. 67p. (In Japanese). Order Number DE93793770. Source: OSTI; NTIS; Available from The Institute of Energy Economics, Dai 10 Mori Biru, 18-1, Toranomon 1-chome, Minato-ku, Tokyo,Japan.

This paper describes discussions given on what effect the EC unification would give on the European energy market, and the future outlook. The EC expects price reduction through intensifying competitions in the energy market as a result of introduction of deregulations and TPA (third party access to pipelines and power transmission cables). Nearly all the barriers have been eliminated in the petroleum market. However, in natural gas and electric utility industries, introducing the deregulations appears to be postponed from policies of the countries who regard supply assurance more importantly. In the middle and eastern European countries, expansion of petroleum demand is expected as a result of expanded network with the western European countries, where the Middle East dependence in place of the former Soviet Union would be further elevated. According to the long-term energy demand and supply forecast published by the EC Committee, the natural gas consumption by 2005 is estimated to grow at 3.9% annually, which might face a restriction from supply capacities. This may result in a high possibility of delay in achieving the target of CO2 emission suppression. 30 figs., 55 tabs.

23720 (INIS-mf–13515) **Environmental procedures.** European Bank for Reconstruction and Development, London (United Kingdom). 1992. [99p.] Order Number DE93626450. Source: OSTI; NTIS (US Sales Only); INIS.

The European Bank has pledged in its Agreement to place environmental management at the forefront of its operations to promote sustainable economic development in central and eastern Europe. The Bank's environmental policy is set out in the document titled, Environmental Management: The Bank's Policy Approach. This document, Environmental Procedures, presents the procedures which the European Bank has adopted to implement this policy approach with respect to its operations. The environmental procedures aim to: ensure that throughout the project approval process, those in positions of responsibility for approving projects are aware of the environmental implications of the project, and can take these into account when making decisions; avoid potential liabilities that could undermine the success of a project for its sponsors and the Bank; ensure that environmental costs are estimated along with other costs and liabilities; and identify opportunities for environmental enhancement associated with projects. The review of environmental aspects of projects is conducted by many Bank staff members throughout the project's life. This document defines the responsibilities of the people and groups involved in implementing the environmental procedures. Annexes contain Environmental Management: The Bank's Policy Approach, examples of environmental documentation for the project file and other ancillary information.

23721 (NEI-DK–1153) **Divisia amount and price index for energy consumption.** Skriftserie K. Nationaloekonomisk Institut, 27. Bentzen, J. Handelshoejskolen i Aarhus (Denmark). Nationaloekonomisk Inst. Feb 1993. 29p. (In Danish). Order Number DE93794689. Source: OSTI; NTIS; INIS.

In connection with the calculation of total energy consumption related to aggregation of the individual fuel's combustion values, an alternative to Btu aggregation (combustion value measurement), designated the "Divisia index", is presented. This represents an economic measure for energy consumption. The Divisia index is demonstrated in relation to total national energy consumption and total energy consumption within the Danish housing sector and also with regard to the estimation of price and income elasticity within energy demand. It is only possible to utilize the Divisia index in relation to the last 20 years, which is the period where energy consumption has stagnated. The question of possible irreversible effects on energy consumption caused by large variations in energy prices is discussed. It is suggested that the reaction to a fall in prices is different and less significant than is the case with price rises. In the long term, results point at a reasonably high price elasticity within energy demand. (AB) (22 refs.).

23722 (NEI-DK–1160) **Danish energy taxation in general.** Energistyrelsen, Copenhagen (Denmark). Jan 1993. 7p. Order Number DE93794757. Source: OSTI; NTIS.

This publication is an abbreviated and edited version of the concluding chapter of "Energibeskatningen i Danmark, afgifter som energipolitisk styringsmiddel og energien som beskatningsobjekt" (Energy taxation in Denmark, taxes as an instrument to control energy policy and energy as an object of taxation) by Kjeld Oksberg. (1989).

It is concluded that Fiscal policy resulted in increased energy taxes in Denmark during 1986 which, although meant to be temporary, have since become permanent as a result of energy policy. In the heating sector energy taxes determine choice of fuel and nature of supply. Heavy demands are placed on the administration of taxes where an energy flow between sectors takes place. Taxes have little effect on energy consumption in the domestic sector. Here the environmental impact can also be negative. There is no clearcut environmental policy related to taxation strategy as taxes do not reflect pollution by normal fuels, they have no relation to flue gas cleaning etc. and the principle applied to "shadow taxation" of decentral combined power and heat plants is different from that applied to other types of supply. Taxation based on energy consumption affects those who are economically less privileged. A considerable amount of subsidies are given to cogeneration and natural gas projects and it is suggested that it may also be advisable to support other projects which do not use oil. Financial support of heating plants through taxation is expedient only if a continuous development and adjustment following the effect of taxes on prices is wished for. (AB).

23723 (ORNL/FTR–4233) **[Travel to Gaborone, Botswana to participate in the African Energy Policy Research Network sixth workshop on energy policy and planning research in east and southern African countries]: Foreign trip report, April 6–10, 1992.** Bauer, D. Oak Ridge National Lab., TN (United States). 17 Apr 1992. 18p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93011112. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The traveler attended the African Energy Policy Research Network (AFREPREN)-Sixth Workshop on Energy Policy and Planning Research in East and Southern African Countries, and made two presentations: on Integrated Resource Planning (IRP) and modeling and forecasting advances in US utilities. He also served as a resource leader for the AFREPREN theme group concerned with Institutions and Planning, helping that group prepare a two year research program in Energy Policy and Energy Planning in East and Southern Africa. The research program and travel and other costs associated with the workshop are supported by the principal donor of AFREPREN, viz. the Swedish Agency for Research Cooperation with Developing Countries (SAREC), Stockholm, Sweden. The principal focus of the Sixth Workshop was to reorient AFREPREN research emphasis toward environmental concerns and the more efficient use of energy. Previous research emphasis had largely been upon the supply-side. The workshop was valuable to DOE and ORNL in providing an opportunity to broaden the transfer of information and analyses relating to efficiency, IRP, and renewables technologies, to assist African research and public policy leaders to direct research and public policies to utilize energy more efficiently and protect the environment more successfully, and to establish

contacts through whom follow-up cooperative programs in such areas as biomass demonstrations, utility planning and operation, and institutional development may occur.

23724 (UCRL-ID–112336) **The Energy Economics Modeling Project and the Lawrence Laboratories Energy Model.** Altenbach, T.; Lamont, A. Lawrence Livermore National Lab., CA (United States). Nov 1993. 47p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE93011715. Source: OSTI; NTIS; GPO Dep.

The Energy Program at Lawrence Livermore National Laboratory has established the Energy Economics Modeling Project to develop economic models of the energy system and use them to address critical national policy questions. The project has developed a new model of the US energy system, known as the Lawrence Laboratories Energy Model (LLEM), and has explored new types of software for building and using energy models. This report summarizes the background and purposes of the Project, and describes the scope, purposes, and status of LLEM.

2903 Environment, Health, and Safety

Refer also to citation(s) 22988, 23137, 23691, 23720, 23765, 23766, 23767, 23768, 23832, 23870, 24127, 24575, 24577, 24630, 24905, 24937, 24938, 24942, 25380

23725 (ANL/EAIS/CP–78705) **RESRAD update.** Yu, C. (Argonne National Lab., IL (United States)); Cheng, J.J.; Zielen, A.J.; Jones, L.G.; LePoire, D.J.; Wang, Y.Y.; Yuan, Y.C.; Loureiro, C.O.; Wallo, A. III; Peterson, H. Argonne National Lab., IL (United States). Environmental Assessment and Information Sciences Div. [1993]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-930601–16: American Nuclear Society (ANS) annual meeting, San Diego, CA (United States), 20-24 Jun 1993). Order Number DE93012892. Source: OSTI; NTIS; INIS; GPO Dep.

A microcomputer program called RESRAD, which implements a pathway analysis method for radiological risk assessment, was developed by Argonne National Laboratory (ANL) in 1989. This program is used to derive allowable residual concentrations of radionuclides in soil and to predict effective dose equivalents and excess cancer incidence risks incurred by an individual exposed to radioactive materials. Since its development, the RESRAD code has been adopted by DOE in Order 5400.5 for the derivation of soil cleanup criteria and dose calculations, and it has been used widely by DOE, other agencies, and their contractors. The original models used by ANL to develop RESRAD were initially developed as part of a DOE effort that began in the early 1980s and involved most of the national laboratories and DOE program offices. The RESRAD code is continuously improved and updated to incorporate comments from users and new features that ease the interaction with users and increase the code's capability and flexibility. The DOE Offices of Environmental Guidance and Environmental Restoration also provide periodic guidance regarding any significant changes to the code. The RESRAD update, Version 5.0, has substantial improvements in many aspects compared with the last version released in 1989.

23726 (BNL–48777) **Pilot study risk assessment for selected problems at the Fernald Environmental Management Project (FEMP).** Hamilton, L.D. (Brookhaven National Lab., Upton, NY (United States)); Meinhold, A.F.; Baxter, S.L.; Holtzman, S.; Morris, S.C.; Pardi, R.; Rowe, M.D.; Sun, C.; Anspaugh, L.; Layton, D. Brookhaven National Lab., Upton, NY (United States); Lawrence Livermore National Lab., CA (United States). Mar 1993. 184p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. Order Number DE93012535. Source: OSTI; NTIS; INIS; GPO Dep.

Two important environmental problems at the USDOE Fernald Environmental Management Project (FEMP) facility in Fernald, Ohio were studied in this human health risk assessment. The problems studied were radon emissions from the K-65 waste silos, and offsite contamination of ground water with uranium. Waste from the processing of pitchblende ore is stored in the K-65 silos at the FEMP. Radium-226 in the waste decays to radon gas which escapes to the outside atmosphere. The concern is for an increase in lung cancer risk for nearby residents associated with radon exposure. Monitoring data and a gaussian plume transport model were used to develop a source term and predict exposure and risk to fenceline residents, residents within 1 and 5 miles of the silos, and residents of Hamilton and Cincinnati, Ohio. Two release scenarios were studied: the routine release of radon from the silos and an accidental loss of one silo dome integrity. Exposure parameters and risk factors were described as distributions. Risks associated with natural background radon concentrations were also estimated.

23727 (CFS/OO–46-13/35-1991E, pp. 4-8) **Opening address.** Roberts, J. (Ministry of the Environment, Ottawa, ON (Canada)). Canadian Forestry Service, Ottawa, ON (Canada). 1991. (CONF-8306311–: Effects of acid rain on forest resources, Sainte-Foy (Canada), 14-17 Jun 1983; MICROLOG–92-03656). In *Effects of acid rain on forest resources: Proceedings.* 667p. Source: PC Forestry Canada, Place Vincent Massey, 351 St. Joseph Blvd., Ottawa, ON, CAN K1A 1G5; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1 PC PRICES UPON REQUEST; MF $10 CAN.

An overview is presented of the status of Canada's forest resources and government policy concerning them, and the threat posed by acid rain. In 1981 a downward revision of allowable cut levels has left provinces facing local shortages of wood. To strengthen the forest resource base, a 40% increase in harvest level by 2000 has been endorsed, which amounts to an annual average increase of 1.8%. To accomplish this within the context of sustainable development, fundamental changes in traditional attitudes regarding forest exploitation will be encouraged. By 1987 $130 million/y will be spent for forest renewal and silviculture, compared with $50 million in 1982. To support human resources development, $1 million has been added to support for forestry schools across the country. Additional funding is being allocated to research and development. Acid rain poses the most immediate threat to Canada's forests. Immediate action is necessary to avoid a situation similar to Sweden, with 20,000 dead lakes, or the American states east of the Mississippi, where 18% of lakes and 21% of stream miles show acid damage. A limitation of acid deposition to 20 kg/ha/y should protect stream, lakes and forests. This will require emissions reductions of 50%, and will cost $1 billion annually in Canada and $2.5-4.5 billion annually in the USA.

23728 (CONF-9207203–, pp. 9-15) **Global warming.: Macrometeorology.** Watanuki, K. (The University of Tokyo, Tokyo (Japan)). 22 Jul 1992. 320p. (In Japanese). From 1. meeting of The Japan Institute of Energy and the 70th Foundation anniversary meeting; Tokyo (Japan); 22-24 Jul 1992. In *Proceedings of the 1st Meeting of the Japan Institute of Energy and the 70th Foundation Anniversary Meeting.* Order Number DE93793523. Source: OSTI; NTIS (US Sales Only).

Scenarios to predict the change in average surface temperature were designed by grasping the global surface as a one input versus one output system containing the four state variables which were average air temperature, albedo, infrared absorption ratio and heat capacity, and then, solving differential equations for it. The input energy consists of that from the sun, that by the heat transfer from inside to surface in the earth and that generated by the human activities, while the output energy does of that going out through electromagnetic radiations from the earth. The equilibrated average surface temperature was obtained by solving the equations framed on condition that there was no change in temperature with time. The aspect of heightening in air temperature was obtained by solving the equations with changing the infrared absorption ratio based on several scenarios. Conventional data and certain hypotheses were applied to the relation between the greenhouse effect gas and infrared absorption ratio. The difference in energy between the input to and output from the earth became global warming energy, from which calculation was done to estimate the mass to be dissolved of Antarctic ice and level to be risen of sea surface. If the heat is effectively transferred to both the polar circles and used for the dissolution of ice, occurrence is possible of a sufficient rise in level of sea surface for largely influencing the human society. 2 figs., 1 tab.

23729 (CONF-9207203–, pp. 16-17) **Global advective transport of passive tracers emitted from Japan.** Chiba, M. (Meteorological Research Institute, Tsukuba (Japan)); Yamazaki, K. 22 Jul 1992. 320p. (In Japanese). From 1. meeting of The Japan Institute of Energy and the 70th Foundation anniversary meeting; Tokyo (Japan); 22-24 Jul 1992. In *Proceedings of the 1st Meeting of the Japan Institute of Energy and the 70th Foundation Anniversary Meeting.* Order Number DE93793523. Source: OSTI; NTIS (US Sales Only).

A global scale advective transport was numerically simulated of passive tracers which were emitted from sources in Japan into the atmosphere by the combustion of fossil fuel, etc. It was hypothesized that the emission rate was constant with time up to the altitude of 300m above the global surface. The wind which was to be a transportation medium was expressed by the values which had been computed in advance every two hours at each of the lattice points by a great cycle circulation model of atmospheric air. Without taking rainfall and other removal processes into consideration, it was also hypothesized that the passive tracers moved completely identically with the air. The spatial distribution was shown as of 20 days after the emission. In case that the initial boundary date was June 4, the emitted passive tracers were advectively transported mostly on the Pacific Ocean but hardly on the southern hemisphere across the equator. In case that the initial boundary date was December 4, the advective transport speed was so high that the transport considerably widened not only into the whole high and medium latitude region of the Northern hemisphere but also to the south-west of Japan. Further, there appeared a high concentration region from the Philippines to the Indian Ocean and the advective transport widened also onto the Southern hemisphere because of a transfer from the lower layer to the upper layer of the troposphere by a very active convection around the above region. 1 fig.

23730 (CONF-9207203–, pp. 18-21) **CO2 emission reduction by global permit trade.** Okada, K. (Central Reserach Institute of Electric Power Industry, Tokyo (Japan)); Yamaji, K.; Nagano, K.; Yamamoto, H.; Osada, K. 22 Jul 1992. 320p. (In Japanese). From 1. meeting of The Japan Institute of Energy and the 70th Foundation anniversary meeting; Tokyo (Japan); 22-24 Jul 1992. In *Proceedings of the 1st Meeting of the Japan Institute of Energy and the 70th Foundation Anniversary Meeting.* Order Number DE93793523. Source: OSTI; NTIS (US Sales Only).

Explanation was done of a CO2 control system which was composed of region-by-region basis measures with CO2-imposed levy, plantation, etc., and international trading in CO2 emission permit. An Edmonds and Reilly's model was utilized to the world energy model with distributing the emission permit to nine regions. The total emission to be worldwidely controlled for the initial term was divided among all the regions into their respective permitted emissions which were to be proportional to their respective population in 2000. The region where the actual emission surpasses the permitted one must either endeavor to reduce the former one or buy an extra permit to offset the surplus emission. On the other hand, the region having an surplus emission permit can make a profit on supplying and selling it to the market. Apart from the CO2 control through the trading in emission permit and other economic measures, introduction was done of plantation which was to absorb, fix and reduce the CO2. Function of adjusting supply and demand operates with international price level for the emission permit based on the curve of supply and demand of that permit in the market. Able to pursue both fair division of responsibility and high efficiency of reduction for the CO2 control, the emission permit market institution, if combined with plantation, functions further as an effective control method. 3 refs., 2 figs.

23731 (CONF-921275–) **Proceedings of the 25th Safety Engineering Study Meeting.** 2 Dec 1992. 160p. (In Japanese). From 25. safety engineering study meeting; Kitakyushu (Japan); 2-3 Dec 1992. Order Number DE93793904. Source: OSTI; NTIS; Available from Japan Soceity for Safety Engineering, 4-47, Onoecho, Nakaku, Yokohama-shi, Kanagawa, Japan.

Among materials with potential danger such as explosion and runaway reaction, the following are studied: peracetic acid, ammonium perchlorate, sodium azide, silane, fused lithium chloride, TEOS (tetraethoxysilane), nitroanthraquinone, etc. As to theories and mechanisms, described are estimation of a runaway starting temperature by giving it disturbance, the thermal stability evaluation method by ARC, DSC, etc. Concerning industrial disaster prevention, studied are LPG underground tanks, human factors of disaster, marine transport of hazardous materials, pulverized coal with danger of fire/explosion at coal mines. Measuring systems for prevention are also made public such as a fire sensor, a system to grasp fire properties, a telephone answering system. Besides, combustion behaviors, fire plume characteristics, electric spark, impact, friction, etc. are fundametally studied in relationships with disaster.

23732 (CONF-921275–, pp. 15-16) **Reaction in ammonium perchlorate-magnesium-water system.** Nagaishi, T. (Kyushu Sangyo University, Fukuoka (Japan)); Suga, T.; Nakamura, H.; Miyahara, A. 2 Dec 1992. 160p. (In Japanese). From 25. safety engineering study meeting; Kitakyushu (Japan); 2-3 Dec 1992. In *Proceedings of the 25th Safety Engineering Study Meeting.* Order Number DE93793904. Source: OSTI; NTIS (US Sales Only).

Gas generating reaction was investigated to discuss safety in a mixture system of ammonium perchlorate (AP), Mg and water. The reaction in this mixture system under presence of water is a heat generating reaction composed of 2NH4ClO4 + Mg → 2NH3 + Mg(ClO4)2 + H2 which may result in ignition if the heat is stored. Products are also dangerous. The AP accelerates gas generation. The smaller the Mg grain size, the gas generation amount and velocity increase. Its pH changes rapidly from 5.6 to 11 as soon as the reaction begins. Residues after the reaction included Mg and Mg(OH), and the filtrate included AP and magnesium perchlorate. The AP turns to a weak acid upon hydrolysis and increases gas generation because Mg can dissolve readily with it. When the gas generation lasts for a certain period of time, a reaction occurs to turn the aqueous solution basic, and the Mg dissolution and the gas generation reach a saturation. Other strong acids including NH4 salt also accelerate the gas generation, and the hydrolysis contributes similarly to changing the solution weakly acidic. 2 figs.

23733 (CONF-921276–, pp. 235-238) **Photochemical CO2 reduction using modified titanium oxide catalyst.** Muramatsu, A. (The University of Tokyo, Tokyo (Japan). Faculty of Engineering); Okawa, K.; Hashimoto, K.; Fujishima, A. 3 Dec 1992. 305p. (In Japanese). From 1992 Japan Solar Energy Society, Japan Wind Energy Association joint converence; Osaka (Japan); 3-4 Dec 1992. In *1992 JSES (Japan Solar Energy Society)/JWEA (Japan Wind Energy Association) Joint Conference.* Order Number DE93793955. Source: OSTI; NTIS (US Sales Only).

A discussion was given on photochemical CO2 reduction using a titanium oxide catalyst modified by Pd and Cu to cope with the CO2 emission problem. TiO2 is a semiconductor which produces electrons and holes using light with larger energy than that in the band gap, the energy of these electrons being capable of reducing CO2. However, because the reduction potential of water is close to that of CO2, a water solution system has CO2 reduction compete with H2 generation. Accordingly, TiO2 was modified with Pd having large hydrogen overvoltage and Cu having high reduction capability. If a TiO2/Pd catalyst is reduced using a Cu plated catalyst, and CO2 is reduced photochemically using the water solution system, generation of H2 and CH4 is suppressed compared with the case using a catalyst not Cu plated, and C2H4, an organic synthesis starting material is generated. A catalyst with Cu on its surface having been oxidized as a result of long term storage after the Cu plating has lost its catalytic activity. The copper should have worked as a specific site for generating C2H4. 2 refs., 3 figs., 3 tabs.

23734 (DOE/EH–93012807) **Update on EH-23 activities in calendar year 1992.** USDOE Assistant Secretary for Environment, Safety, and Health, Washington, DC (United States). [1992]. 19p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93012807. Source: OSTI; NTIS; GPO Dep.

This report briefly describes the activities undertaken by the DOE Office of Environmental Guidance (EH-23) in Calendar Year (CY) 1992 in seven major areas: (1) regulatory review and analysis, (2) environmental policy and guidance, (3)training, (4) workgroups and committees, (5) environmental regulatory management support, (6) projects and other activities, and (7) special presentations. A list of

selected environmental guidance memoranda and documents distributed by EH-23 in CY 1992 is also included.

23735 (EUR–14715) **Research and technology strategy to help overcome the environmental problems in relation to transport. Resource uses study.** Billings, R. (Environmental Research Unit, Dublin (Ireland)); Crowley, J.; Moran, R. Commission of the European Communities, Luxembourg (Luxembourg). Apr 1992. [159p.] Source: OSTI; NTIS (US Sales Only); INIS.

This report concerns the environmental impact of resource utilization in the transport sector. The first phase of the study involved a dissection of transport into its different modes, its operational components, and its existing patterns of resource usage. The second phase was an investigation of existing environmental impacts. Since in principle a significant environmental impact may occur anywhere along the extraction-to-disposal life cycle of a material, it was necessary to investigate a range of environmental phenomena upstream and downstream from the transport sector, as well as within the sector itself. In this development of a holistic perspective of resource usage, particular attention was paid to depletion, disposal, and re-cycling questions. The third phase involved the examination of possible innovations in transport technology. Of particular interest was the resource usage implications of these innovations, and their potential for ameliorating negative environmental impacts. In the final phase of the study, are addressed questions of the net costs and benefits of the various technologies, and of the most appropriate policy options for the Community.

23736 (LBL–33230) **Economics, ethics, and climate policy.** Howarth, R.B.; Monahan, P.A. Lawrence Berkeley Lab., CA (United States). Nov 1992. 70p. Sponsored by Stockholm Environment Inst. (Sweden). DOE Contract AC03-76SF00098. Order Number DE93015373. Source: OSTI; NTIS; GPO Dep.

Are the costs of greenhouse gas emissions abatement justified by the perceived benefits of sustained climate stability? Do people of the present generation have a moral right to impose climate risks on their descendants in generations to come? This report examines these questions in light of the emergent facts of climate science and their socioeconomic implications. We consider alternative normative criteria for social decision-making with particular emphasis on cost-benefit analysis and the principle of sustainable development. While each framework yields important insights, we argue that the gross uncertainties associated with climate change and the distribution of impacts between present and future generations constrain the usefulness of cost-benefit criteria in evaluating climate policy. If one accepts the ethical proposition that it is morally wrong to impose catastrophic risks on unborn generations when reducing those risks would not noticeably diminish the quality of life of existing persons, a case can be made for concerted policy action to reduce greenhouse gas emissions.

23737 (LBL-PUB–3115) **Guidelines for compliance with the National Environmental Policy Act and the California Environmental Quality Act.** Kielusiak, C. Lawrence Berkeley Lab., CA (United States). Feb 1993. 57p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. Order Number DE93010436. Source: OSTI; NTIS; GPO Dep.

The National Environmental Policy Act of 1969 (NEPA) sets forth national policy for the protection of the environment. The NEPA process is intended to help officials of the federal government make decisions that are based on an understanding of environmental consequences, and take actions that protect, restore, and enhance the environment. The California Environmental Quality Act of 1970 (CEQA) is similar to NEPA. The California legislature established CEQA to inform both state and local governmental decision-makers and the public about potential significant environmental effects of proposed activities, to identify ways to avoid or reduce environmental impacts, and to disclose to the public the reasons why a project is approved if significant environmental effects are involved. Lawrence Berkeley Laboratory (LBL), complies with the provisions of both NEPA and CEQA. This document defines the responsibilities and authorities for NEPA/CEQA compliance at LBL.

23738 (NEDO-P–9109) **CO recovery from thermal power generation plants.** New Energy and Industrial Technology Development Organization, Tokyo (Japan). Mar 1992. 214p. (In Japanese). Sponsored by New Energy and Industrial Technology Development Organization, Tokyo (Japan). Order Number DE93794621. Source: OSTI; NTIS; Available from New Energy and Industrial Technology Development Organization, Sunshine 60, 30F 1-1, 3-chome, Higashi-Ikebukuro, Toshima-ku, Tokyo, Japan.

As a part of the measures taken against the global warming, developmental trend studies and case studies are made for technologies of power generation, CO2 recovery and treatment of recovered CO2, to find a course of the study of the systems to recover CO2 from thermal power plants. CO2 recovery systems are selected which have high potential in each kind of fuel and each power generation method for a plant with a generating end output of 600,000 kW to be newly constructed in the beginning of 2000, and their energy efficiency, CO2 reduction effects and economical efficiency are evaluated. Chemical/physical CO2 recovery from flue gas and CO2 separation from precombustion gas by steam reforming seem to be promising in LNG combined cycle, pulverized coal-fired, oxygen blown integrated coal gasification combined cycle, air blown integrated coal gasification combined cycle, and reformed methanol thermal power plants. For treatment of the recovered CO2, considered are marine, underground and oil well disposals. At existing thermal plants where kinds of fuel used are specified, recovery from the coal-fired power generation plant which is low in required power per recovery amount is profitable. At newly constructed plants where kinds of fuel used are open to choice, recovery from LNG- and methanol-thermal power generation plants which are low in CO2 emission is profitable.

23739 (NEDO-P–9126) **Analysis on factors affecting energy consumptions and CO2 emissions and their regional and sectoral differences.** New Energy and Industrial Technology Development Organization, Tokyo (Japan). Mar 1992. 244p. (In Japanese). Sponsored by New Energy and Industrial Technology Development Organization, Tokyo (Japan). Order Number DE93794623. Source: OSTI; NTIS; Available from New Energy and Industrial Technology Development Organization, Sunshine 60, 30F 1-1, 3-chome, Higashi-Ikebukuro, Toshima-ku, Tokyo, Japan.

A common analyzing method was applied to analyze factors relating to CO2 emission in 15 OECD countries, the former Soviet Union, East European countries, and major 15 countries in developing regions. The analyses performed in each country included those on change in factors for energy consumption and CO2 emission brought about by the oil crises, change in CO2 emission because of slowed-down economic growth, factor change in CO2 emission seen by sectors (manufacturing industries, transportation sector, and power generation) as a result of energy saving and fuel conversion efforts, factor change in CO2 emission from energies thrown into the power generating sector, and factor change in CO2 emission in manufacturing industries. The result showed that the factor change common to CO2 emission patterns in industrialized nations is the suppression in CO2 emission as a result of the economic growth stagnation because of the oil crises and the progress of the energy saving efforts. Introduction of nuclear power in the power generation sector has contributed to reducing CO2 emission in a number of countries. The change due to the oil crises was thought to have led to suppression in CO2 emission. Future problems in suppressing CO2 emission are described. 136 figs., 35 tabs.

23740 (NEI-DK–1149, pp. 112-120) **Potential and barriers in EC-countries for energy production from animal manure.** Breinholt, T. (Danish Energy Agency, Copenhagen (Denmark)). Commission of the European Communities, Brussels (Belgium). Directorate General for Energy; Energy Centre Denmark, Copenhagen (Denmark). 1992. (CONF-9210360–: European seminar on collective biogas plants. European experience in combined manure and waste processing, Herning (Denmark), 22-23 Oct 1992). In *Collective biogas plants: European experience in combined manure and waste processing. Proceedings.* 249p. Order Number DE93794674. Source: OSTI; NTIS.

A THERMIE Programme Action.

A regional evaluation of which European regions within EC can be viewed as most favourable as regards biogas production from animal manure has been carried out. On the basis of a number of primary and secondary criteria such as livestock density, energy

prices, rules and regulations, farming practices and nitrate load in groundwater, all regions within the EC have been analysed. Weighed values have been attributed to each parameter, and by aggregate value analysis, the most favourable regions in Europe have been identified. Furthermore, the gross energy potential has been computed, and a number of barriers have been identified in each member state. (au).

23741 (ORNL/M–2648) **Environmental Regulatory Update Table, January–February 1993.** Houlberg, L.M.; Hawkins, G.T.; Salk, M.S.; Danford, G.S.; Lewis, E.B. Oak Ridge National Lab., TN (United States). Mar 1993. 124p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93009791. Source: OSTI; NTIS; GPO Dep.

The Environmental Regulatory Update Table provides information on regulatory initiatives of interest to DOE operations and contractor staff with environmental management responsibilities. The table is updated bi-monthly with information from the Federal Register and other sources, including direct contact with regulatory agencies. Each table entry provides a chronological record of the rulemaking process for that initiative with an abstract and a projection of further action.

23742 (ORNL/TM–2648/R1) **Environmental Regulatory Update Table, March/April 1993: Revision 1.** Houlberg, L.M.; Hawkins, G.T.; Salk, M.S.; Danford, G.S.; Lewis, E.B. Oak Ridge National Lab., TN (United States). May 1993. 108p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93013469. Source: OSTI; NTIS; GPO Dep.

The Environmental Regulatory Update Table provides information on regulatory initiatives of interest to DOE operations and contractor staff with environmental management responsibilities. The table is updated bimonthly with information from the Federal Register and other sources, including direct contact with regulatory agencies. Each table entry provides a chronological record of the rulemaking process for that initiative with an abstract and a projection of further action.

23743 (WHC-SA–1690) **Continuous spectrum analysis: An approach for analyzing alternatives and impacts of potential projects.** Eccleston, C.H. Westinghouse Hanford Co., Richland, WA (United States). Mar 1993. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. (CONF-930523–6: 18. National Association of Environmental Professionals (NAEP) annual conference on current and future priorities for environmental management, Raleigh, NC (United States), 24-26 May 1993). Order Number DE93011358. Source: OSTI; NTIS; INIS; GPO Dep.

The Hanford Site, located in southeastern Washington State, is owned by the US Government and managed by the US Department of Energy, Richland Field Office (RL). Two coal-fired steam plants currently supply steam for various uses in the 200 Areas of the Hanford Site. These steam plants have outlived their usefulness and need to be replaced. A reliable source of steam is needed to support future environmental remediation and waste management activities. The National Environmental Policy Act (NEPA) of 1969, requires that all federal actions must be evaluated before a final decision can be made to pursue a proposed action or one of its alternatives. The NEPA process is expected to begin early in the planning process for a proposed action. Normally, the NEPA process is implemented by first preparing a preliminary engineering study of the proposed action and its alternatives. Once this study has been completed, it provides the data and is used as the basis for preparing an analysis of the potential impacts required under NEPA. Under NEPA, all reasonable alternatives for replacing the current steam supply system must be considered and evaluated. Possible alternatives include renovating the existing steam plants or constructing a new gas-fired boiler to replace the existing plants. Because of its high efficiency, it also appears reasonable that a cogeneration plant could be constructed that would produce both steam and electricity. The alternative of taking no action to replace the existing steam supply system (i.e., no-action) and continuing to operate the existing steam plants must also be analyzed under the NEPA process.

23744 (WSRC-IM–93-017) **Environmental Implementation Plan.** Westinghouse Savannah River Co., Aiken, SC (United States). 15 Mar 1993. 598p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE93013583. Source: OSTI; NTIS; INIS; GPO Dep.

The purpose of the Environmental Implementation Plan (EIP) is to show the current and future (five years) environmental plans from individual site organizations and divisions, as well as site environmental programs and initiatives which are designed to protect the environment and meet or exceed changing environmental/regulatory requirements. Communicating with site organizations, departments, and committees is essential in making the site's environmental-planning process work. The EIP gives the site the what, when, how, and why for environmental requirements. Through teamwork and proactive planning, a partnership for environmental excellence is formed to achieve the site vision for SRS to become the recognized model for Environmental Excellence in the Department of Energy's Nuclear Weapons Complex.

2904 Energy Resources

Refer also to citation(s) 22747

23745 (DOE/FTR–93011427) **[Travel to Honduras to discuss plans to incorporate renewable energy technologies into rural electrification and water pumping programs]: Foreign trip report, October 28–November 12, 1992.** Harcourt, M.M. II. Sandia National Labs., Albuquerque, NM (United States). 16 Dec 1992. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. Order Number DE93011427. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Mr. Max Harcourt visited Tegucigalpa and Roatan Island, Honduras. In Tegucigalpa, he met with the staff of the National Rural Electric Cooperative Association Central American Rural Electrification Support (NRECA/CARES) program, representatives of the US Agency for International Development (US AID) and the United States Peace Corps, members of various Private Development Organizations (PDOs) involved with rural development, electrification and water systems, and with members of the Honduran national utility (ENEE). Discussions with AID and the PDOs centered around AID's water projects in support of the national health program - Salud II - and the possibility of incorporating renewable energy power sources into their project planning. While there was considerable interest, and no institutional obstacles from AID, it remains the decision of each PDO that is receiving funding from Salud II as to how they want to execute their projects. Some, notably APRODIB on the island of Roatan, are using PV; however, others are concentrating on grid-powered systems and have not addressed many remote sites as yet. Discussions with the Peace Corps focused on their institutionalization of photovoltaics promotion as part of their small business sector and plans for installation of up to 3,500 systems in the Tela area over the next five years. Meetings with ENEE involved discussions of their rural electrification plans and what steps might be taken to incorporate renewable energy options into their planning.

2905 Research, Development, Demonstration, and Commercialization

Refer also to citation(s) 22649, 22835, 23258, 23774, 23775, 23776, 23780, 23867, 23932, 24183, 24187

23746 (CONF-920791–, pp. 5, Paper 4) **Environmental management technology integration opportunities for industry.** Sink, C. (Dept. of Energy, Washington, DC (US)). USDOE Assistant Secretary for Environmental Restoration and Waste Management, Washington, DC (United States). Jul 1992. From Information exchange meeting on characterization sensors and monitoring technologies; Dallas, TX (United States); 15-16 Jul 1992. In *Proceedings of the information exchange meeting on characterization, sensors, and monitoring technologies.* 261p. Order Number DE93005318. Source: OSTI; NTIS.

The U.S. Department of Energy's (DOE) Environmental Restoration and Waste Management Office of Technology Development

leads an aggressive national program for applied research, development, demonstration, testing, and evaluation (RDDT&E) to address environmental restoration and waste management technology deficiencies by enhancing technology beyond current capabilities. The objective of this RDDT&E program is to support DOE's 30-year cleanup goal by delivering environmental restoration technologies for faster, better, safer, and cheaper cleanup of DOE sites to bring them into compliance for protecting health, public safety, and the environment. These technologies, once successfully demonstrated in DOE's test beds, are made available for transfer to potential users and commercial markets. Recognizing private industry, university, and other government agency RDDT&E as sources of innovations, Technology Development is committed to working with small businesses and other industry to build public-private sector partnerships. These partnerships serve three purposes. First, they make available to DOE the best available technologies developed externally to evaluate for site cleanup. Second, the partnerships serve as a means to move successfully-demonstrated technologies across the DOE complex. Third, once the technologies have been tested or adapted for DOE's environmental cleanup needs, these partnerships are critical to DOE activities which transfer the technologies to: Environmental management businesses to commercialize marketable products and processes; Sister federal research and development (R&D) agencies for sites cleanup; and State and local agencies for regional economic development initiatives which create new jobs and improve standards of living.

23747 (CONF-920791–, pp. 5, Paper 6) **DOE International Technology Exchange Program (ITEP): Technical integration of sensor technology development.** DuCharme, A.R. (Sandia National Labs., Albuquerque, NM (US)); Silva, R.J.; Bickford, D.F. USDOE Assistant Secretary for Environmental Restoration and Waste Management, Washington, DC (United States). Jul 1992. From Information exchange meeting on characterization sensors and monitoring technologies; Dallas, TX (United States); 15-16 Jul 1992. In *Proceedings of the information exchange meeting on characterization, sensors, and monitoring technologies.* 261p. Order Number DE93005318. Source: OSTI; NTIS.

To achieve the goal of remediating waste sites throughout its complex and of bringing its facilities into full compliance by the year 2019, the DOE has established the Office of Environmental Restoration and Waste Management (EM). Within EM, the Office of Technology-Development (OTD) has been created to develop technologies that will support DOE's cleanup goal. The OTD is accelerating remediation technology application by leveraging the expenditure of available funds through international technology development and demonstration projects. These projects will address EM's environmental restoration and waste management needs. For this reason, the OTD has created the International Technology Exchange Program (ITEP) whose primary objective is to effect collaboration among governments, industries, and educational institutions to identify worldwide technologies suitable for this purpose. These technologies should also meet U.S. commercial needs. The ITEP will also serve as a mechanism for transferring technologies developed under DOE sponsorship to U.S. industry for ultimate application in the international arena.

23748 (DOE/ID–10217(93)) **Institutional Plan, FY 1993–1998, Idaho National Engineering Laboratory.** USDOE Idaho Field Office, Idaho Falls, ID (United States). [1993]. 134p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-76ID01570. (INEL/MISC–92172). Order Number DE93012172. Source: OSTI; NTIS; INIS; GPO Dep.

This document presents the plans and goals of the Idaho National Engineering Laboratory for FY 1993–1998. Areas discussed in this document include: INEL strategic view; initiatives; scientific and technical programs; environmental, safety, and health management, technology transfer, science and math education, and community affairs; human resources; site and facilities; and resource projections.

23749 (LA-SUB–93-46/1) **[Los Alamos National Laboratory industrial applications and technology transfer]: Final report.** Los Alamos National Lab., NM (United States); Los Alamos Economic Development Corp., NM (United States). 30 Sep 1992. 195p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. Order Number DE93008402. Source: OSTI; NTIS; GPO Dep.

In October 1989, the Los Alamos Economic Development Corporation (LAEDC) entered into a contract with the Industrial Applications office (IAO) of Los Alamos National Laboratory (LANL) whereby the LAEDC was to provide support services to IAO. More specifically, according to the Statement of Work in this contract "The Los Alamos Economic Development Corporation shall assist the Los Alamos National Laboratory Industrial Applications Office in establishing and strengthening connections between potential entrepreneurs at the Laboratory and the business assistance community throughout New Mexico, directed toward enhancing the number, of successful start up businesses spinning off the Laboratory's technology base." As part of this contract and subsequent modifications thereof, the LAEDC was to perform seven tasks: 1. Provide business planning assistance to potential entrepreneurs. 2. (Assist IAO in preparing and distributing) informational materials on technology transfer. 3. (Organize and manage) meetings and seminars on technology transfer and entrepreneurship. 4. Identify new opportunities for technology transfer. 5. (Identify and implement programs for the) recognition of Laboratory Entrepreneurs. 6. Training Lab personnel, in the area of technology transfer and Laboratory industrial interactions. 7. Review and summarize prior New Mexico economic development studies. The purpose of this report, is to summarize the accomplishments of the LAEDC under its contract with IAO, and to fulfill its reporting requirements. This report covers the period from October 1989 to September 1992.

23750 (LA-SUB–93-46/2) **[Los Alamos National Laboratory industrial applications and technology transfer]: Annual report, [October 1990–September 1991].** Los Alamos National Lab., NM (United States); Los Alamos Economic Development Corp., NM (United States). 31 Oct 1991. 97p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. Order Number DE93008403. Source: OSTI; NTIS; GPO Dep.

This report summarizes the accomplishments of the Los Alamos Economic Development Corporation (LAEDC) under its contract with the Industrial Applications Office (IAO). The LAEDC has: provided business planning assistance to potential entrepreneurs, assisted IAO in preparing and distributing informational materials on technology, organized and managed meetings and seminars on technology transfer and entrepreneurship, identified new opportunities for technology transfer, and identified and implemented programs for the recognition of Laboratory entrepreneurs.

23751 (NEI-DK–1149, pp. 166-170) **Financing possibilities and programmes concerning biogas in the Netherlands.** Braber, K.J. (NOVEM B.V., Utrecht (Netherlands)). Commission of the European Communities, Brussels (Belgium). Directorate General for Energy; Energy Centre Denmark, Copenhagen (Denmark). 1992. (CONF-9210360–: European seminar on collective biogas plants. European experience in combined manure and waste processing, Herning (Denmark), 22-23 Oct 1992). In *Collective biogas plants: European experience in combined manure and waste processing. Proceedings.* 249p. Order Number DE93794674. Source: OSTI; NTIS.

A THERMIE Programme Action.

An overview is presented of existing programmes dealing with manure treatment and anaerobic digestion in general and manure digestion more specifically. Furthermore, the Dutch situation with respect to financing investment projects is outlined. Finally, a preview of possible future programmes and financing opportunities is given. (AB).

23752 (NEI-FI–207) **Research overview 1990-1991.** National Board of Waters and the Environment, Helsinki (Finland). Water and Environment Research Inst. 1992. 16p. Order Number DE93794797. Source: OSTI; NTIS.

According to the 1986 Act of the Finnish Water and Environment Administration the NBWE and the WERI carry out environmental research and monitor the quality of the environment, especially of waters and develop and maintain information systems in this field. In recent years the WERI has actively expanded its range of expertise. Presently the research of the WERI covers most aspects of water research. New rapidly developing areas include waste and

chemicals research and conservation ecology. The research field of the WERi is classified into some 20 problem-oriented smaller research areas which in toll include 180 research projects. The monitoring programme of the institute, revised every second year, includes the following topics: hydrological monitoring, water quality monitoring, monitoring of bio-accumulation of toxic chemicals, integrated and terrestrial monitoring and data banks. The annual research programme of the institute covers areas such as climatic change and airborne pollution, hydrological analyses and models, water quality, toxic chemicals, groundwater, industrial and municipal pollution control, non-point pollution from agriculture and forestry, conservation ecology and development and standardization of methods. The research results are published in international journals and in the Publications of the Water and Environment Research Institute.

23753 (PNL-SA–22022) **The AMTEX Partnership.** Lemon, D.K. Pacific Northwest Lab., Richland, WA (United States). [1993]. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93009816. Source: OSTI; NTIS; GPO Dep.

The American Textile Partnership, as its name implies, is a collaborative effort between the DOE national labs and industry-related R&D/educational institutions. The purpose of AMTEX is to promote R&D that enhance the competitiveness of the integrated textile industry (i.e., fibers, textiles, sewn/fabricated products). The industry-related organizations bring a vital perspective of industry needs in addition to their own R&D capabilities. The DOE labs bring broad R&D capabilities and perspectives from other areas of research application. The strong synergy between industry and DOE will enable this collaboration to significantly impact industry competitiveness while focusing and strengthening, the labs' capabilities consistent with DOE's mission. There are three main components in AMTEX: DOE/ER oversight; the Operating Committee, which is composed a Laboratory Board and an Industry Board; and five Technology Area Coordination Teams (TACTs).

23754 (SAND–93-1003) **Testing technology: A Sandia technology bulletin.** Goetsch, B.; Floyd, H.L.; Doran, L. (eds.). Sandia National Labs., Albuquerque, NM (United States). Apr 1993. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. Order Number DE93013080. Source: OSTI; NTIS; GPO Dep.

This bulletin presents state of the art testing technology utilized at Sandia National Laboratory. A hand-held NiCad battery tester automatically checks batteries of individual cells. Modal analysis shows the way to better process control for integrated circuit lithography. An ultrasonic system pings reentry vehicles to measure in-flight ablation. A smaller VISAR shines in detonator tests. Higher image quality is achieved at neutron radiography facility with the use of a neutron collimator.

2906 Nuclear Energy

Refer also to citation(s) 22909, 23353, 23473, 23474, 23476, 23477, 23480, 23765

23755 (DOE-STD–1050-93) **Guideline to good practices for planning, scheduling, and coordination of maintenance at DOE nuclear facilities.** USDOE, Washington, DC (United States). Mar 1993. 61p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93014266. Source: OSTI; NTIS; GPO Dep.

The purpose of the Guideline to Good Practices for Planning, Scheduling, and Coordination of Maintenance at DOE Nuclear Facilities is to provide contractor maintenance organizations with information that may be used for the development and implementation of a rigorously controlled maintenance program directed at planning, scheduling, and coordinating work packages for maintenance tasks at DOE nuclear facilities. This document is intended to be an example guideline for the implementation of DOE Order 4330.4A, Maintenance Management Program, Chapter II, Element 6. DOE contractors should not feel obligated to adopt all parts of this guide. Rather, they should use the information contained herein as a guide for developing maintenance programs that are applicable to their facility.

23756 (DOE-STD–1051-93) **Guideline to good practices for maintenance organization and administration at DOE nuclear facilities.** USDOE, Washington, DC (United States). Mar 1993. 66p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93013951. Source: OSTI; NTIS; GPO Dep.

The purpose of the Guideline to Good Practices for Maintenance Organization and Administration at DOE Nuclear Facilities is to provide contractor maintenance organizations with information that may be used to verify adequacy of and/or modify existing maintenance organization programs, or to develop new programs. This document is intended to be an example guideline for the implementation of DOE Order 4330.4A, Maintenance Management Program, Chapter 2, Element 1. DOE contractors should not feel obligated to adopt all parts of this guide. Rather, they should use the information contained herein as a guide for developing programs that are applicable to their facility.

23757 (DOE-STD–1052-93) **Guideline to good practices for types of maintenance activities at DOE nuclear facilities.** USDOE, Washington, DC (United States). Mar 1993. 108p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93014267. Source: OSTI; NTIS; GPO Dep.

The purpose of the Guideline to Good Practices for Types of Maintenance at DOE Nuclear Facilities is to provide contractor maintenance organizations with information that may be used for the development and implementation of a properly balanced corrective, preventive and predictive maintenance program at DOE nuclear facilities. This document is intended to be an example guideline for the implementation of DOE Order 4330.4A, Maintenance Management Program, Chapter II, Element 4. DOE contractors should not feel obligated to adopt all parts of this guide. Rather, they should use the information contained herein as a guide for developing maintenance programs that are applicable to their facility.

23758 (DOE-STD–1053-93) **Guideline to good practices for control of maintenance activities at DOE nuclear facilities.** USDOE, Washington, DC (United States). Mar 1993. 36p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93014268. Source: OSTI; NTIS; GPO Dep.

The purpose of the Guideline to Good Practices for Control of Maintenance Activities at DOE Nuclear Facilities is to provide contractor maintenance organizations with information that may be used for the development and implementation of a rigorously controlled maintenance program directed at achieving high quality work performance, personnel safety, radiological protection, operating equipment/system protection, and overall site safety and reliability at DOE nuclear facilities. This document is intended to be an example guideline for the implementation of DOE Order 4330.4A, Maintenance Management Program, Chapter II, Element 7. DOE contractors should not feel obligated to adopt all parts of this guide. Rather, they should use the information contained herein as a guide for developing maintenance programs that are applicable to their facility.

23759 (DOE-STD–1054-93) **Guideline to good practices for control and calibration of measuring and test equipment (M&TE) at DOE nuclear facilities.** USDOE, Washington, DC (United States). Mar 1993. 34p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93013952. Source: OSTI; NTIS; INIS; GPO Dep.

The purpose of the Guideline to Good Practices for Control and Calibration of Measuring and Test Equipment (M&TE) at DOE Nuclear Facilities is to provide contractor maintenance organizations with information that may be used for the development and implementation of a rigorously controlled maintenance program directed at controlling and calibrating M&TE used for maintenance tasks at DOE nuclear facilities. This document is intended to be an example guideline for the implementation of DOE Order 4330.4A, Maintenance Management Program, Chapter II, Element 11. DOE contractors should not feel obligated to adopt all parts of this guide. Rather, they should use the information contained herein as a guide for developing an M&TE program applicable to their facility.

23760 (DOE-STD–1055-93) **Guideline to good practices for maintenance management involvement at DOE nuclear facilities.** USDOE, Washington, DC (United States). Mar 1993. 21p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93013953. Source: OSTI; NTIS; GPO Dep.

The purpose of the Guideline to Good Practices for Maintenance Management Involvement at DOE Nuclear Facilities is to provide contractor maintenance organizations with information that may be used to verify adequacy of and/or modify existing maintenance management programs, or to develop new programs. This document is intended to be an example guideline for the implementation of DOE Order 4330.4A, Maintenance Management Program, Chapter 2, Elements 14 and 16. DOE contractors should not feel obligated to adopt all parts of this guide. Rather, they should use the information contained herein as a guide for developing maintenance management programs that are applicable to their facility.

23761 (NUREG–0325-Rev.16) **US Nuclear Regulatory Commission functional organization charts, March 15, 1993: Revision 16.** Nuclear Regulatory Commission, Washington, DC (United States). Office of Personnel. Mar 1993. 64p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). Source: OSTI; NTIS; INIS; GPO.

Functional organization charts for the US Nuclear Regulatory Commission offices, divisions, and branches are presented.

23762 (SAND–93-1152C) **INMM International Safeguards Division status report.** Sonnier, C.S. (Sandia National Labs., Albuquerque, NM (United States)); Case, R.S.; Ek, P. Sandia National Labs., Albuquerque, NM (United States). 28 Apr 1993. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-930533–3: 15. annual symposium of the European Safeguards Research and Development Association: safeguards and nuclear materials management, Rome (Italy), 11-13 May 1993). Order Number DE93013769. Source: OSTI; NTIS; GPO Dep.

In July 1990 the Institute of Nuclear Materials Management (INMM) "International Safeguards Subcommittee", an arm of the INMM "Safeguards Committee", held its first meeting, which was devoted principally to organizational matters. The goal of this organization is to promote International Safeguards as a major tool of Non Proliferation policies. Within the framework of the INMM, it has the responsibility to provide a forum for exchange of information related to further development of selected aspects of International Safeguards, and to enhance a broader understanding of these topics. A second meeting of this "Subcommittee" was held at the 1991 INMM Annual Meeting. In November 1991, the INMM reorganized into "Divisions", with the establishment of the "International Safeguards and Non Proliferation Division" (IS&NP). From November 1991, the IS&NP Division met two times, once in Europe and once in the USA. In October 1992, further reorganization of the INMM led to establishment of the "International Safeguards Division" (ISD) which, under the new designation, has met two times, once in Europe and once in Japan. This paper presents the purpose, objectives, results of past meetings, and future plans of the ISD.

2910 Conservation

Refer also to citation(s) 23773, 23816

23763 (PNL-SA–22016) **Utility and state industrial EMS incentives programs: Experience and success factors.** Roop, J.M.; Stucky, D.J. Pacific Northwest Lab., Richland, WA (United States). Mar 1993. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-9303108–2: 15. national industrial energy technology conference, Houston, TX (United States), 24-25 Mar 1993). Order Number DE93011601. Source: OSTI; NTIS; GPO Dep.

This paper summarizes the results of a survey of utility and state demand-side management (DSM) programs that address efficient motor systems. The paper discusses the incentive structures in place at both the state and utility levels to encourage efficient motor systems, and the market barriers associated with implementation of efficient motor equipment. The paper also assesses how the current incentives might address the market barriers to the implementation of efficient motor systems.

2920 Supply, Demand, and Forecasting

Refer also to citation(s) 23716, 23719, 23724

23764 (ETDE-mf–93795636) **Economy in figures '92.** Bundesministerium fuer Wirtschaft, Bonn (Germany). Oct 1992. 186p. (In German). Order Number DE93795636. Source: OSTI; NTIS (US Sales Only).

This compilation of tables contains important economic data on the following areas: population; occupational activities, working time; income and expenditure; gross national product; economic branches (manufacturing industry, shipbuilding, energy economy, building industry, agriculture, the crafts, transport, the Press, tourism, trade); external trade; Germany in the European integration; social budget; financial policy; promotion of research and development; promotion measures. (HS).

23765 (NREL/TP–461-4857) **Trends in public perceptions and preferences on energy and environmental policy.** Farhar, B.C. National Renewable Energy Lab., Golden, CO (United States). Feb 1993. 417p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-83CH10093. Order Number DE93000069. Source: OSTI; NTIS; GPO Dep.

This report presents selected results from a secondary analysis of public opinion surveys, taken at the national and state/local levels, relevant to energy and environmental policy choices. The data base used in the analysis includes about 2000 items from nearly 600 separate surveys conducted between 1979 and 1992. Answers to word-for-word questions were traced over time, permitting trend analysis. Patterns of response were also identified for findings from similarly worded survey items. The analysis identifies changes in public opinion concerning energy during the past 10 to 15 years.

2930 Policy, Legislation, and Regulation

Refer also to citation(s) 22988, 23075, 23352, 23478, 23479, 23719, 24577, 25383

23766 (PNL-SA–22216) **Risk communication in environmental restoration programs.** Bradbury, J.A. Pacific Northwest Lab., Richland, WA (United States). Apr 1993. 18p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-9304130–1: The risk assessment paradigm after ten years, Dayton, OH (United States), 5-8 Apr 1993). Order Number DE93013286. Source: OSTI; NTIS; GPO Dep.

The author advocates adoption of a convergence model in place of the traditional source-receiver model of communication for communicating with members of the public who have a stake in remediation of a nearby site. The source-receiver model conceives of communication as the transmission of a message from a risk management agency (sender) to a target audience of the public (receivers). The underlying theme is that the sender intends to change the perception of the receiver of either the issue or the sender of information. The theme may be appropriate for health campaigns which seek to change public behavior; however, the author draws on her experience at a DOE site undergoing remediation to illustrate why the convergence model is more appropriate in the context of cleanup. This alternative model focuses on the Latin derivation of communication as sharing or making common to many, i.e., as involving a relationship between participants who engage in a process of communication. The focus appears to be consistent with recently issued DOE policy that calls for involving the public in identifying issues and problems and in formulating and evaluating decision alternatives in cleanup. By emphasizing context, process and participants, as opposed to senders and receivers, the model identifies key issues to address in facilitating consensus concerning the risks of cleanup. Similarities between the institutional context of DOE and DOD suggest that a convergence model may also prove to be an appropriate conceptual foundation for risk communication at contaminated DOD sites.

2940 Fossil Fuels

Refer also to citation(s) 22649, 22835, 23717, 23727, 23765

23767 (CONF-9207203–) **Proceedings of the 1st Meeting of the Japan Institute of Energy and the 70th Foundation Anniversary Meeting.** 22 Jul 1992. 320p. (In Japanese). From 1. meeting of The Japan Institute of Energy and the 70th Foundation anniversary meeting; Tokyo (Japan); 22-24 Jul 1992. Order Number DE93793523. Source: OSTI; NTIS; Available from The Japan Institute of Energy, 5-4, Sotokanda 6-chome, Chiyoda-ku, Tokyo (Japan).

As for the environmental problem, reported are prediction of depletion of fossil resources and CO2 emissions, and the global permit trade and reduction of CO2 emission, etc. As to natural gas, notice is taken of its inorganic origin and deep gas. Concerning coal structure, studies are made particularly on elucidation of noncovalent interactions and applications to coal utilization. Regarding coal utilization technology, the paper takes up coal-water slurry fuel, coprocessing of coal and bitumen and a residueless coal gasification method, coal gasification, coal gasification combined cycle power generation, and coal pyrolysis. Relating to coke production and utilization, elucidation of process behaviors, improvement of productivity, and development of new carbon materials are described. With respect to new fuels, diverse developments are seen in cellulose, oil sand residues, and synthesis gas. In the session of automobiles and chemistry, emphasis is placed on engine combustion technology and measures against exhaust gas emission. Study for commercialization of fuel cells is also reported.

23768 (CONF-9207203–, pp. 1-8) **Viewpoint on global warming from fossil fuel reserves.: Study subjects for the next century.** Shitaka, Y. (Center for Coal Utilization, Japan, Tokyo (Japan)). 22 Jul 1992. 320p. (In Japanese). From 1. meeting of The Japan Institute of Energy and the 70th Foundation anniversary meeting; Tokyo (Japan); 22-24 Jul 1992. In *Proceedings of the 1st Meeting of the Japan Institute of Energy and the 70th Foundation Anniversary Meeting.* Order Number DE93793523. Source: OSTI; NTIS (US Sales Only).

The issue of global warming caused by CO2 emission is studied in consideration of life cycles of fossil fuels to find the subjects in the 21st century. Annual supply of fossil fuels will increase for the time being, but turn to a decrease with the first half of the 21st century as its peak, because coal cannot make up for substantial declines in petroleum and natural gas. CO2 concentration will have an inflection point during the first half of the next century and afterward indicate a gentle rise till it reaches a peak after 400-500 years from now during which fossil fuels will deplete. Ultimately the concentration will be 800ppm. Anyhow, it is necessary to predict not only an energy outlook only with a steady increase but changes and ultimate values of the CO2 concentration from all the life cycles of fossil fuels. It is the same to the prediction on man's future life and economy. Particularly, it is important to have a basic program which is firm and comprehensive to introduce new energy and non-fossil energy such as nuclear energy, plant resources, geothermal resources and solar energy. Also required is the program to convert the society to the one which is slim in energy and considers the environment important by means of energy conservation and recycling of resources. 7 figs., 1 tab.

2960 Electric Power

Refer also to citation(s) 23352, 23702, 23765

23769 (NEI-FI–201) **Strategies for controlled islanding of a regional power producer.** Jyrinsalo, J. Tampere Univ. of Technology (Finland). Dept. of Electrical Engineering. 1991. 100p. (In Finnish). Order Number DE93794777. Source: OSTI; NTIS.

In this study preconditions for islanding and island operation of a regional power producer were searched for. Three municipal electric utilities owning local power generation were studied (Helsinki, Oulu and Tampere). A simulation program written in Tampere University of Technology was utilized. The local subtransmission networks (110 kV) with the connected components were modelled for the simulation studies. By making simulation as well as analytical studies both network operation and protection methods were developed which improve the controllability of the islanding and the island operation. The most essential improvements suggested were a new separation frequency, frequency control by both frequency- and time-coordinated load shedding procedure and voltage control by a proper reactive power compensation strategy. The functioning of both overcurrent and earthfault relays during island operation were also studied. The simulation results were verified with a primary test, comparison calculations and a sensitivity analysis. The results of the study were utilized to outline some basic principles which aid any power producer in planning its islanding scheme. Proposals were also made concerning the national emergency control practices.

2980 Consumption and Utilization

Refer also to citation(s) 23852

23770 (NEI-DK–1145) **Denmark 1900-1991: Energy consumption, GDP and energy prices.** Skriftserie K. Nationaloekonomisk Institut, 25. Bentzen, J. Handelshoejskolen i Aarhus (Denmark). Nationaloekonomisk Inst. Feb 1993. 32p. (In Danish). Order Number DE93794687. Source: OSTI; NTIS.

The aim was to illustrate and generally analyze data for energy consumption and prices in Denmark during the period 1990-1991. In relation to the presented data on gross and net energy consumption the significance of climate correction is discussed and graphs show the effective price of energy. The long-term connection between energy consumption, energy prices and gross domestic product at factor cost is debated. It is demonstrated how the relation between energy, and gross domestic product at factor cost, develops, and the level of domestic supply of energy during the current century is described. It is explained that, up to 1970, energy consumption had increased at an alarming rate which can be related to the national income during that period. Lately, increases have been more gradual, related to high, effective energy prices. It is stated that some influential effects are irreversible, such as improvements in thermal insulation in buildings and technical energy-saving innovations, and because of this even a fall in energy prices will not result in a return to former levels of energy consumption. The possibility of a new energy price shock in the future could excite even more energy saving activities. In the short term it is more difficult to see the relation between energy consumption and national income development, there are so many influential factors, such as gross domestic product, weather, prices and the number of domiciles etc., to take into consideration. But the estimation of long term elasticity of national income and prices rests at anticipated levels. (AB) (24 refs.).

23771 (NEI-DK–1146) **Energy consumption and energy prices: A comparison of the development in 9 OECD lands 1951-1990.** Skriftserie K. Nationaloekonomisk Institut, 26. Bentzen, J. Handelshoejskolen i Aarhus (Denmark). Nationaloekonomisk Inst. Feb 1993. 30p. (In Danish). Order Number DE93794688. Source: OSTI; NTIS; INIS.

Data are presented on energy consumption and energy prices related to a number of OECD (Organisation for Economic Co-operation and Development) lands covering the period 1951-1990. The information sources are described and the development of energy consumption and prices in Denmark are illustrated in relation to these other countries. The energy intensity (the relation between energy consumption and the gross national product) is dealt with. Here it is possible to follow development during the whole post-war period. It is generally understood that Denmark saved large amounts of energy after 1973-74 but, taken over the whole post-war period, savings and decline in energy-gross national product relations are less dramatic compared to conditions in other OECD countries. Energy coefficients or elasticities show the relative rise in consumption compared to the relative rise in gross national product (growth rate). This is shown to be typically unstable and an eventual connection with the amount of energy price increase and/or the growth rate of the national economy is considered. Results of Granger causuality tests on energy consumption, national income and energy prices are presented. Effective energy prices were very low in Denmark up to 1970 when they suddenly began to increase. Since the oil crisis Denmark's energy consumption has

fallen whereas the other countries have used rather more energy than before. Effective promotion of energy savings must be seen in relation to the fact that the 1970 basis level of energy consumption and intensity was unusually high. The high effective energy prices have also encouraged energy savings in Denmark. (AB).

2990 Unconventional Sources and Power Generation

Refer also to citation(s) 23209, 23303, 23740, 23751, 23765, 23768, 23780

23772 (NEDO-P–9101) **Present situation in new energy related cooperation and its future direction (the U.S.A.).** New Energy and Industrial Technology Development Organization, Tokyo (Japan). Mar 1992. 61p. (In Japanese). Sponsored by New Energy and Industrial Technology Development Organization, Tokyo (Japan). Order Number DE93794616. Source: OSTI; NTIS; Available from New Energy and Industrial Technology Development Organization, Sunshine 60, 30F 1-1, 3-chome, Higashi-Ikebukuro, Toshima-ku, Tokyo, Japan.

With an objective of promoting effectively and efficiently the development and introduction of petroleum substituting energies in Japan, this paper describes investigations on how the petroleum substituting energies are developed and introduced in the U.S.A. The U.S. energy strategy was analyzed as to the oil production, nuclear energy, hydraulic power generation, natural gas, and coal. The energy saving measures being discussed include tax deduction on power generation using renewable energy sources including solar energy, and finances for energy efficiency improving plans. The paper also introduces a summary of part of the energy policies adopted in seven countries including Germany, Canada, and Japan. The present situation in the alternative energy industries is described with explanations on the organizations and plans of the renewable energy trade committee (CORECT), an outline of the U.S.'s international cooperation for energies, and four events in the solar energy industry. It is not too much to say that the U.S. energy industry is in a chaos, and it was concluded that the industry is not ready to dedicate itself in international cooperation. 10 tabs.

23773 (NEDO-P–9102) **Present situation in new energy related cooperation and its future direction (Canada).** New Energy and Industrial Technology Development Organization, Tokyo (Japan). Mar 1992. 78p. (In Japanese). Sponsored by New Energy and Industrial Technology Development Organization, Tokyo (Japan). Order Number DE93794617. Source: OSTI; NTIS; Available from New Energy and Industrial Technology Development Organization, Sunshine 60, 30F 1-1, 3-chome, Higashi-Ikebukuro, Toshima-ku, Tokyo, Japan.

With an objective of promoting effectively and efficiently the development and introduction of petroleum substituting energies in Japan, this paper describes investigations on how the petroleum substituting energies are developed and introduced in Canada and its international activities. According to the estimation made by the Canadian Energy Department, the consumption rates in different energies would not show a large change during the coming two decades. Efficiency improvement in household room heating and air conditioning is listed first as a measure to reduce the energy demand. According to a calculation, a complete implementation of this measure would reduce the household energy consumption by 45% compared with that in 1989 by 2010. The paper also explains means to reduce illumination power consumption in commercial sectors, energy demand in manufacturing industries, and exhaust gases associated with natural gas production, as well as development plans and international activities on energy efficiencies and alternative energies. It is apparent that Canada gives priorities to expansion of natural gas utilization and power generation using nuclear and hydraulic power to reduce the nation's dependence on petroleum. 16 tabs.

23774 (NEDO–P-9103) **Present situation in new energy related cooperation and its future direction (the United Kingdom).** New Energy and Industrial Technology Development Organization, Tokyo (Japan). Mar 1992. 50p. (In Japanese). Sponsored by New Energy and Industrial Technology Development Organization, Tokyo (Japan). Order Number DE93794618. Source: OSTI; NTIS; Available from New Energy and Industrial Technology Development Organization, Sunshine 60, 30F 1-1, 3-chome, Higashi-Ikebukuro, Toshima-ku, Tokyo, Japan.

With an objective of promoting effectively and efficiently the development and introduction of petroleum substituting energies in Japan, this paper describes investigations on policies for petroleum substituting energies, research and development activities, and international cooperation in the U.K. Since the U.K. produces petroleum and natural gas in abundance, its main objective to develop and introduce oil substituting energies is closely related to global environmental problems, the reduction of greenhouse effect gases in particular, rather than assuring energy resources. The Government published a white paper on the environment in 1990, which sets forth a principle of suppressing carbon dioxide emission in 2005 to the level in 1990. High-priority research and development plans include solar energy utilization and development, on which the Government intends to work positively. The nation's international cooperation is based mostly on the framework with the EC countries, where the basic energy policy held up by the EC of environmental protection and energy saving promotion would continue influencing the nation's efforts. 8 figs., 5 tabs.

23775 (NEDO-P–9104) **Present situation in new energy related cooperation and its future direction (France).** New Energy and Industrial Technology Development Organization, Tokyo (Japan). Mar 1992. 69p. (In Japanese). Sponsored by New Energy and Industrial Technology Development Organization, Tokyo (Japan). Order Number DE93794619. Source: OSTI; NTIS; Available from New Energy and Industrial Technology Development Organization, Sunshine 60, 30F 1-1, 3-chome, Higashi-Ikebukuro, Toshima-ku, Tokyo, Japan.

With an objective of promoting effectively and efficiently the development and introduction of petroleum substituting energies in Japan, this paper describes results of the investigations on energy policies, the current situation in new energy development, and the international cooperation for the area of new energies in France. The Government announced the 'Energy 2010' in 1990, a governmental guideline for the next two decades. The guideline describes the necessity of more flexible use of the conventional nuclear power emphasizing policy, introduction of alternative fuels into the transportation sector, and advocates introduction of gas and electric vehicles. The paper also shows the results of investigating the energy policies adopted by the French Energy Administration Bureau (AFME) as to the manufacturing industries, raw materials, transportation, biomasses, and new energies. France is thought not placing emphasis on technical researches for new and renewable energies (excluding nuclear energy), and the direction of its nuclear power policy is dependent on the petroleum situation. A consideration is given on the nation's assistance mechanism. 3 figs., 16 tabs.

23776 (NEDO-P–9105) **Present situation in new energy related cooperation and its future direction (Germany).** New Energy and Industrial Technology Development Organization, Tokyo (Japan). Mar 1992. 99p. (In Japanese). Sponsored by New Energy and Industrial Technology Development Organization, Tokyo (Japan). Order Number DE93794620. Source: OSTI; NTIS; Available from New Energy and Industrial Technology Development Organization, Sunshine 60, 30F 1-1, 3-chome, Higashi-Ikebukuro, Toshima-ku, Tokyo, Japan.

With an objective of promoting effectively and efficiently the development and introduction of petroleum substituting energies in Japan, this paper describes results of the investigations on situations around the energy policies and new energies, trends in research and development in oil substituting energies, the actual state of assistance and cooperation to developing countries for new energies, and the international cooperation on EC's new energy technologies in Germany. The German energy policies are being implemented on the basis of shifting to nuclear power generation because of coal cost increase and considering the global environmental problems including greenhouse effect gas problem. Specifically, utilizing renewable energies including solar heat energy and nuclear energy as an alternative energy is advocated. With respect to the assistant cooperation to developing countries,

German investments have reached over 10% of the total aid amount, and were used for more than 100 projects. Majority of the projects are for those related to solar heat energy utilization, particularly the area of photovoltaic cells having been most successful. 4 figs., 7 tabs.

23777 (NEI-DK–1149, pp. 78-91) **The problem of excess manure in the Netherlands: Environment and legislation. Future development and role of biogas production.** Voorburg, J.H. (IMAG-DLO, Wageningen (Netherlands)). Commission of the European Communities, Brussels (Belgium). Directorate General for Energy; Energy Centre Denmark, Copenhagen (Denmark). 1992. (CONF-9210360–: European seminar on collective biogas plants. European experience in combined manure and waste processing, Herning (Denmark), 22-23 Oct 1992). In *Collective biogas plants: European experience in combined manure and waste processing. Proceedings.* 249p. Order Number DE93794674. Source: OSTI; NTIS.

A THERMIE Programme Action.

The problem of excess manure in the Netherlands is aggravated by the fact that legal measures where taken at a moment when the volume of the surplus exceeded by far the available possibilities for disposal. The problem was approached by a considering policy, reduction of P and N content in animal feed, distribution to arable regions and manure processing. Opinions differ on the possibilities to solve the problem of excess manure in 1995. The impact of manure surpluses is nutrient losses from manure which is considered not to be in excess. Land-spreading in autumn and winter leads to severe N-losses caused by leaching and run-off. High animal density results in a volume of ammonia evaporation which makes the NH_x depostion a main factor related to acid precipitation. Measures to reduce losses in the form of leaching and evaporation are successful. Development has started towards a reduction of the ammonia emission from housing and storage. Dutch farmers became aware of the inefficiency to their management of crop nutrients and aim at an improved nutrient balance. A result of these measures will be a further reduction of the application rate of manure and fertilizers, which means an increase of the manure surplus. The production of biogas is a challenging aspect of manure management. Introduction into the system of manure distribution to arable regions deserves serious consideration. (AB).

23778 (NEI-DK–1149, pp. 122-128) **The value of manure and organic waste: National differences.** Gosch, A. (Fachhochschule Gessen-Friedberg, Biogas-Laboratory for Research and Technology (Germany)). Commission of the European Communities, Brussels (Belgium). Directorate General for Energy; Energy Centre Denmark, Copenhagen (Denmark). 1992. (CONF-9210360–: European seminar on collective biogas plants. European experience in combined manure and waste processing, Herning (Denmark), 22-23 Oct 1992). In *Collective biogas plants: European experience in combined manure and waste processing. Proceedings.* 249p. Order Number DE93794674. Source: OSTI; NTIS.

A THERMIE Programme Action.

The nutrient value of manures as multifertilizers, and the biogas potentials of organic household wastes, are demonstrated by the use of tables. Resources in Germany are illustrated, and two designs for biomass conversion plants are presented in the form of diagrams. (AB).

23779 (NEI-DK–1149, pp. 160-164) **The THERMIE energy technology programme of the Commission of the European Communities in relation to collective biogas plants.** Fabry, R. (Directorate-General for Energy Commission of the European Communities (Belgium)); Nacfaire, H. Commission of the European Communities, Brussels (Belgium). Directorate General for Energy; Energy Centre Denmark, Copenhagen (Denmark). 1992. (CONF-9210360–: European seminar on collective biogas plants. European experience in combined manure and waste processing, Herning (Denmark), 22-23 Oct 1992). In *Collective biogas plants: European experience in combined manure and waste processing. Proceedings.* 249p. Order Number DE93794674. Source: OSTI; NTIS.

A THERMIE Programme Action.

The THERMIE energy technology programme of the European Community is presented with a special accent on the sector "Energy from Biomass and Waste" and more particularly on the centralised or large scale biogas plants for the treatment of manure and/or other organic waste. The main other Community programmes which can also be relevant for this particular subject are briefly reviewed. (au).

30 DIRECT ENERGY CONVERSION

Refer also to citation(s) 23257

23780 (DOE/CE/90053–T47) **Interagency Advanced Power Group, steering group meeting minutes.** Horizon Data Corp., Reston, VA (United States). Power Information Center. 21 Apr 1993. 95p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC01-90CE90053. Order Number DE93014558. Source: OSTI; NTIS; GPO Dep.

A guest speech was given by Douglas Allen on the impact of the Clinton administration on power research and development. It mentions the Russia factor (RTG, MHD, propulsion). The following working group and panel reports were given: chemical (fuel cell, battery, capacitor), mechanical (terrestrial and aerospace power), electrical (pulse, power conditioning, superconductivity), nuclear, and solar (PV, thermal). At the business meeting, status reports were given for the power information center and IAPG membership.

3001 MHD Generators

23781 (ANL/CMT/CP–78930) **Heat and Seed Recovery Technology Project.** Swift, W.M.; Petrick, M.; Natesan, K. Argonne National Lab., IL (United States). [1993]. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-930270–1: MHD contractor's review meeting, Pittsburgh, PA (United States), 2-4 Feb 1993). Order Number DE93009203. Source: OSTI; NTIS; GPO Dep.

The objective of this work is to address technical issues related to both the MHD topping and bottoming cycles and to their integration. Design information will be obtained through modeling and experimentation. This information, together with the insults of long duration testing at DOE's Coal Fired Flow Facility (CFFF) and Component Development and Integration Facility (CDIF), can be used to reliably design the first-generation MHD retrofit plant. Work during the reporting period focused on the following tasks: (1) computer modeling of the integrated topping-cycle power train (combustor/nozzle/channel/diffuser); (2) evaluation of materials for the bottoming steam cycle; (3) systems analysis of an MHD/CO_2 cyde; and (4) the completion of a topical report on the reactivation of the ANL superconducting magnet system. Accomplishments in these areas are described briefly.

23782 (LA–12482-MS) **Advanced magnetic flux compression generator development issues: A comparison of coaxial and disk generators.** Sheppard, M.G.; Freeman, B.L. Los Alamos National Lab., NM (United States). Apr 1993. 33p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. Order Number DE93014025. Source: OSTI; NTIS; GPO Dep.

Three magnetic flux compression generator (FCG) geometries are reviewed and compared for their suitability as high-current, high-power drivers for z-pinch implosion programs at Los Alamos. They are the inside-out coaxial FCG, the disk FCG, and the outside-in coaxial FCG. A wide range of issues is discussed for each type FCG including current-carrying capability current densities, robustness, explosive mass and shape, initiation schemes, efficiency, operating times, complexity, and expense associated with development and fabrication. Equations are derived and used in simple scaling studies. The results of these studies are supported by MHD calculations and references to relevant experiments both here and in Russia. The inside-out coaxial FCG is shown to be suitable, both for the very high current applications and for anticipated future Trailmaster concepts. Based upon this analysis and results reported in the Russian literature, the inside-out coaxial FCG is more suitable than the disk FCG for the high-current applications considered, and the two are roughly equivalent when

applied to lower-current Trailmaster concepts. The outside-in coaxial FCG is unsuitable for either application because of its limited current-carrying capability and the large investment required for initial development.

3005 Fuel Cells

Refer also to citation(s) 23228, 23868

23783 (CONF-9207203–, pp. 291-295) **Current status of research and development of fuel cell power generation technology.** Hirose, K. (Agency of Industrial Science and Technology, Tokyo (Japan)). 22 Jul 1992. 320p. (In Japanese). From 1. meeting of The Japan Institute of Energy and the 70th Foundation anniversary meeting; Tokyo (Japan); 22-24 Jul 1992. In *Proceedings of the 1st Meeting of the Japan Institute of Energy and the 70th Foundation Anniversary Meeting.* Order Number DE93793523. Source: OSTI; NTIS (US Sales Only).

The present paper describes the trend of research and development of various fuel cells in the Moonlight Project from 1981 up to now. Based on the results obtained until then, development of a 5000kW class power generation plant for Urban Energy Center and a 1000kW class power plant for cogenerator system has been advanced both using phosphate type fuel cells since 1991. One target is to attempt to realize a power plant of up to 1000kW class per one stack by raising current density to 350mA/cm^2 and advancing lamination of cells with an aim of cost reduction and improvement in reliability for promoting the propagation of this type of fuel cell. Concerning fused carbonate type fuel cells, each cell of composite large capacity type stack, modified large capacity type and internally reformed type is being studied aiming at the establishment of a 1000kW class power generation system by 1997. Besides, a developmental study is being forwarded on the solid electrolyte type fuel cell while aiming at realization of several ten kW class modules by 1995 through the development of several kW class modules and the polymer type fuel cell while aiming realization of 1kW class modules. 1 fig.

23784 (CONF-9207203–, pp. 296-299) **Graphic exergy analysis of fuel-cell systems baased on energy-utilization diagrams.** Ishida, M. (Tokyo Institute of Technology, Tokyo (Japan). Research Laboratory of Resources Utilization); Yamamoto, M. 22 Jul 1992. 320p. (In Japanese). From 1. meeting of The Japan Institute of Energy and the 70th Foundation anniversary meeting; Tokyo (Japan); 22-24 Jul 1992. In *Proceedings of the 1st Meeting of the Japan Institute of Energy and the 70th Foundation Anniversary Meeting.* Order Number DE93793523. Source: OSTI; NTIS (US Sales Only).

Energy Utilization Diagram(EUD) was applied to the fuel-cell system and its usefulness was actually shown by expressing the characteristics on EUD by five parameters. A formula, EXL=δH_{ea} (A_{ed}-A_{ea}) $\geq$ 0, shows the exergy, EXL, given at the time when energy of quality, A_{ed}, is converted to energy of quantity, δ H_{ea}, quality, A_{ea}, (where ed, ea represent energy donor, energy acceptor respectively). According to the diagram of EUD in which energy levels, A and δH_{ea}, are represented by ordinate and abscissa respectively, the electromotive force generated in a fuel cell is expressed in the form of a rectangular area corresponding to exergy loss. It is understood from the case study obtained by inputting actual figures to the PAFC plant of Goi and an imaginary system of SOFC that EUD can be drawn with a small number of data and allows a systematic representation of different phenomena such as reaction system, heat-exchange system and power system. 7 figs., 1 tab.

23785 (CONF-9207203–, pp. 300-304) **Launching toward phosphoric acid fuel cell commercialization.** Matsushita, T. (Toshiba Corp., Tokyo (Japan)); Shiba, Y. 22 Jul 1992. 320p. (In Japanese). From 1. meeting of The Japan Institute of Energy and the 70th Foundation anniversary meeting; Tokyo (Japan); 22-24 Jul 1992. In *Proceedings of the 1st Meeting of the Japan Institute of Energy and the 70th Foundation Anniversary Meeting.* Order Number DE93793523. Source: OSTI; NTIS (US Sales Only).

The developmental history of phosphoric acid fuel cell in Japan is reviewed and the tasks and measures in the present condition are described. In the Moonlight Project initiated in 1981, two 1MW demonstration plants and two kinds(for isolated islands, for business use) of on-site 200kW-class power plants were developed by 1991 with their own purposes fulfilled. In the private section also, a 11MW demonstration plant of large scale power started its operation in 1991 and a large number of small-scale on-site tests have been conducted. It can be said that the fuel cell power generation in the section is one step before its commercialization now. Governmental aids for propagation of this power generation system have been covering reconsideration of approval for construction and various regulations for system linking, introduction of tax system, financing and subsidiary beneficial to this system. While the commercialization of the phosphoric acid fuel cell seems to come soon, the present tasks are, above all, reduction of the cost 3-4 times as high as that of usual power generation facilities. Next, there can be listed reliability, compactness, efficient heat utilization, diversification of fuel, etc. 2 figs.

23786 (CONF-9207203–, pp. 305-306) **Fuel cell development in gas industry.** Koga, M. (Japan Gas Association, Tokyo (Japan)); Kitagawa, S. 22 Jul 1992. 320p. (In Japanese). From 1. meeting of The Japan Institute of Energy and the 70th Foundation anniversary meeting; Tokyo (Japan); 22-24 Jul 1992. In *Proceedings of the 1st Meeting of the Japan Institute of Energy and the 70th Foundation Anniversary Meeting.* Order Number DE93793523. Source: OSTI; NTIS (US Sales Only).

Since the fuel cell using natural gas is highly efficient in power generation and superior in adaptability to environment, fuel gas suppliers are active in the development of this technology. This paper describes the present status of this matter in Japan. Concerning the situation of developing, for example, on-site PAFCs, three gas companies and F Electric Company started the joint manufacture of several tens of experimental machines in the classes of 50 - and 100kW in 1992 and will conduct field tests and monitor tests in the sites of customers of each gas company in preparation for commercialization through mass production in 1993. Furthermore, NEDO and three gas companies successfully finished the demonstration test of a 200kW machine installed in Plaza Hotel of Osaka in October of 1991. Demonstration tests of a 500kW machine and a 1000kW machine are being advanced by the joint development of O gas company and F Electric Company and that of NEDO and Phosphoric Acid Fuel Cell Association respectively. The final demonstration test in the latter is scheduled to be done in 1995-1996. 1 fig.

23787 (CONF-9207203–, pp. 307-310) **Development of 25kW class multiple large capacity type molten carbonate fuel cell.** Otsuka, K. (Hitachi, Ltd., Tokyo (Japan)); Kahara, T.; Takashima, S.; Takeuchi, M.; Fujimura, H. 22 Jul 1992. 320p. (In Japanese). From 1. meeting of The Japan Institute of Energy and the 70th Foundation anniversary meeting; Tokyo (Japan); 22-24 Jul 1992. In *Proceedings of the 1st Meeting of the Japan Institute of Energy and the 70th Foundation Anniversary Meeting.* Order Number DE93793523. Source: OSTI; NTIS (US Sales Only).

MCFC(Molten Carbonate Fuel Cell) is being developed under the principal sponsorship of NEDO within the framework of the Moonlight Project of Agency of Industrial Science and Technology in Japan. This report describes the features of multiple large capacity type MCFC stack and the developmental situation of a 25kW class stack in the project. It is necessary for realization of high output to enlarge the cell area and laminate a plurality of unit cells. Until now, the largest fuel cell in the world was developed which has 1.2m^2 of effective area by arranging four unit cells each having an area of 3,025cm^2. A 25kW class cell which is obtained by laminating 22 multiple large capacity type MCFCs each having an area of 1.2m^2 satisfied the expected purpose in performance tests and will be a prototype for the future. A pressure operation of 5700h was successfully finished, providing hopeful prospect. Efforts will be made for eliminating the scatter among cells and improving performance, reliability and service-life toward 1MW class machine hereafter. 4 figs., 2 tabs.

23788 (CONF-9207203–, pp. 311-314) **Study of cogeneration system in molten carbonate fuel cell power generation plant.** Nakao, K.; Terashi, T.; Horiuchi, N. 22 Jul 1992. 320p. (In Japanese). From 1. meeting of The Japan Institute of Energy and the 70th Foundation anniversary meeting; Tokyo (Japan); 22-24 Jul

1992. In *Proceedings of the 1st Meeting of the Japan Institute of Energy and the 70th Foundation Anniversary Meeting.* Order Number DE93793523. Source: OSTI; NTIS (US Sales Only).

The waste heat utilization system, heat unit price, etc. in the case where molten carbonate fuel cell power generation is operated as cogeneration system were evaluated and investigated using an office building as model. While electric power, cold heat and hot heat are supplied with power load follow-up operation adopted for office building, a turbo-refrigerator and a hot water boiler were supplemented for additional burning of cold and hot heat. The following results were obtained by simulating a 1MW class and a 20MW class power generation plants, assuming a certain extent of fluctuation of annual electric power and heat demand. Since heat-to-power ratios used in the simulation were not so good, the shares due to additional burning were so high that 65-85% and 45-60% were allotted for cold heat and hot heat respectively and heat supply from fuel cell power generation was small. This system gave about 35-45% energy saving compared with the conventional heat supply system by recovering waste heat as cold heat and hot heat. Scale merit appeared significantly in the case of the 20MW system, being half of the 1MW system. 2 refs., 3 figs., 1 tab.

23789 (CONF-9207203–, pp. 315-316) **Statement for early commercialization of solid oxide fuel cell.** Ipponmatsu, M. (Osaka Gas Co. Ltd., Osaka (Japan)). 22 Jul 1992. 320p. (In Japanese). From 1. meeting of The Japan Institute of Energy and the 70th Foundation anniversary meeting; Tokyo (Japan); 22-24 Jul 1992. In *Proceedings of the 1st Meeting of the Japan Institute of Energy and the 70th Foundation Anniversary Meeting.* Order Number DE93793523. Source: OSTI; NTIS (US Sales Only).

'Committee for coal-gasified-fuel cell' of the Japan Society of Energy, inaugurated in January of 1990, started a full-scale discussion on the problem of the relation between effective application of coal and SOCF(Solid Oxide Fuel Cell). The present report describes the tasks for the SOFC system around the results of this discussion. A feasibility study was carried out with respect to a system of Texaco-type coal gasification + Westinghouse-type SOFC + gas turbine + steam turbine. An approach to system optimization in the form of varying fuel utilization rate in the range of 60-80% produced the results of analysis that lowering of fuel utilization rate brings about the rise of overall efficiency. This is because SOFC works in a temperature as high as 1000°C makes a full use of the sensible heat of waste gas; as a result, importance of setting the optimum fuel utilization rate was recognized regarding the system design. 1 tab.

23790 (DOE/MC/25168–3291) **Advanced alternate planar geometry solid oxide fuel cells: Final report.** Elangovan, S. (Ceramatec, Inc., Salt Lake City, UT (United States)); Prouse, D.; Khandkar, A.; Donelson, R.; Marianowski, L. Ceramatec, Inc., Salt Lake City, UT (United States); Institute of Gas Technology, Chicago, IL (United States). Nov 1992. 83p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC21-88MC25168. Order Number DE93000248. Source: OSTI; NTIS; GPO Dep.

The potential of high temperature Solid Oxide Fuel Cells as high performance, high efficiency energy conversion device is well known. Investigation of several cell designs have been undertaken by various researchers to derive the maximum performance benefit from the device while maintaining a lower cost of production to meet the commercialization cost target. The present investigation focused on the planar SOFC design which allows for the use of mature low cost production processes to be employed. A novel design concept was investigated which allows for improvements in performance through increased interface stability, and lowering of cost through enhanced structural integrity and the use of low cost metal interconnects. The new cell design consisted of a co-sintered porous/dense/porous zirconia layer with the electrode material infiltrated into the porous layers. The two year program conducted by a team involving Ceramatec and the Institute of Gas Technology, culminated in a multi-cell stack test that exhibited high performance. Considerable progress was achieved in the selection of cell components, and establishing and optimizing the cell and stack fabrication parameters. It was shown that the stack components exhibited high conductivities and low creep at the operating temperature. The inter-cell resistive losses were shown to be small through out-of-cell characterization. The source of performance loss was identified to be the anode electrolyte interface. This loss however can be minimized by improving the anode infiltration technique. Manifolding and sealing of the planar devices posed considerable challenge. Even though the open circuit voltage was 250 mV/cell lower than theoretical, the two cell stack had a performance of 300 mA/cm^2 at 0.4V/cell with an area specific resistance of 1 Ω-cm^2/cell. improvements in manifolding are expected to provide much higher performance.

23791 (LA-UR–93-1689) **Electrocatalysis issues in polymer electrolyte fuel cells.** Wilson, M.S.; Derouin, C.R.; Valerio, J.A.; Gottesfeld, S. Los Alamos National Lab., NM (United States). [1993]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930804–2: 28. intersociety energy conversion engineering conference, Atlanta, GA (United States), 8-13 Aug 1993). Order Number DE93014450. Source: OSTI; NTIS; GPO Dep.

Various electrocatalysis issues of impotance to low platinum loading polymer electrolyte fuel cells (PEFCs) are discussed. Thin film catalyst layer assemblies are used to investigate the effects of CO and CO_2 on the anode as well as efforts to restore performance by oxygen bleeding into the anode feedstream. These electrodes behave differently than ionomer-impregnated E-TEK electrodes because the extra, exposed Pt in the latter case. The tolerance of Pt-Ru alloy thin film anodes to CO and CO_2 are also evaluated. Thin film electrodes are also used to study Pt particle growth in aged electrodes as well as particle size effects on specific activity.

23792 (NEI-DK–1158) **High temperature fuel cells based on oxygen ion conductors: Final report.** Mogensen, M. Risoe National Lab., Roskilde (Denmark). Materials Dept. Jan 1993. 205p. (In Danish). Contract ENS-1443/89-6. Order Number DE93794737. Source: OSTI; NTIS.

EFP-89.

The results of a project carried out by Risoe National Laboratory in cooperation with a Danish commercial company (Haldor Topsoee A/S) are presented in the form of a collection of individual papers already published. The aim of the project was to develop methods of powder preparation and fabrication of the La(Sr)MnO_3 electrode, partly to investigate the oxidation of CH_4 and H_2 on CeO_{2-x} based electrodes and partly to build up equipment for the control of gas flow and measuring of the gas composition. The results of the separate projects are very briefly summarized. (AB).

23793 (NEI-DK–1158, pp. 1-2) **Anodes for solid oxide fuel cells.** Mogensen, M. (Materials Department, Risoe National Laboratory, Roskilde (Denmark)); Malmgren-Hansen, B.; Kindl, B. Risoe National Lab., Roskilde (Denmark). Materials Dept. Jan 1993. Contract ENS-1443/89-6. In *High temperature fuel cells based on oxygen ion conductors: Final report.* 205p. Order Number DE93794737. Source: OSTI; NTIS.

Short communication. SOLID ELECTROLYTE FUEL CELLS/anodes; ANODES; OXIDATION; METHANE; ELECTROCHEMISTRY; TEMPERATURE RANGE 1000-4000 K; CERIUM OXIDES; CARBON; DEPOSITION; MATERIALS TESTING; NICKEL OXIDES; ZIRCONIUM OXIDES; YTTRIUM OXIDES

23794 (NEI-DK–1158, pp. 1-2) **Automatic performance of electrochemical experiments.** Malmgren-Hansen, B. (Materials Department, Risoe National Laboratory, Roskilde (Denmark)); Mogensen, M.; Poulsen, F.W. Risoe National Lab., Roskilde (Denmark). Materials Dept. Jan 1993. Contract ENS-1443/89-6. In *High temperature fuel cells based on oxygen ion conductors: Final report.* 205p. Order Number DE93794737. Source: OSTI; NTIS.

Short communication. SOLID ELECTROLYTE FUEL CELLS/materials testing; SOLID ELECTROLYTE FUEL CELLS/computer graphics; ELECTRODES; COMPUTERIZED CONTROL SYSTEMS; TEMPERATURE CONTROL; ELECTROCHEMISTRY

32 ENERGY CONSERVATION, CONSUMPTION, AND UTILIZATION

23795 (VTT-TIED–1334) **Energy use and emission scenarios to the year 2000 for Estonia.** Taehtinen, M. (Technical

Research Centre of Finland, Espoo (Finland). Nuclear Engineering Lab.); Nurste, H. Technical Research Centre of Finland, Espoo (Finland). 1992. 47p. Order Number DE93794841. Source: OSTI; NTIS.

Baltic Nordic cooperation in the field of energy and environment.

In the independent Estonia an energy crisis is forthcoming or partly already existing reality. The fuel consumption is estimated to decrease by 20-30 % in the scenarios considered by the year 2000. Oil-shale is the most important fuel and almost the sole domestic fuel in Estonia. It, however is a problematic fuel with low calorific value, high ash content implying large environmental problems. In the scenarios considered it has been supposed that no new oil-shale mines will be opened and the consumption of oil-shale will decrease. Only the use of natural gas is estimated to increase clearly. The given fuel consumption scenarios are favourable from the environmental point of view. All calculated emissions (SO_2, NO_x and CO_2) are decreasing. Without ordinary emission reduction measures, the sulfur emissions are estimated to decrease over 30 % from the level of the year 1980 by the year 2000. If the assumed emission reduction plans of the oil-shale plants will be realized, the sulfur emissions will decrease over 60 %. Because there are no reduction plans for nitrogen oxides and carbon dioxide, the decline of emissions of these substances is due to the decreasing energy production. The emissions of nitrogen oxides are estimated to decrease by 10-20 % compared with the emissions of 1987 and those of carbon dioxide by 20-30 % compared with the emissions of 1990.

3201 Buildings

Refer also to citation(s) 22762, 23233, 23254, 23282, 23283, 23292, 23691, 23763, 23833, 23852, 24007, 24008

23796 (AUC-IBT-R–9149) **Modelling complex inlet geometries in CFD - applied to air flow in ventilated rooms.** Indoor Environmental Technology Paper, 21. Skovgaard, M.; Nielsen, P.V. Aalborg Universitetscenter (Denmark). Inst. for Bygningsteknik. Dec 1991. 17p. (CONF-9109312–4: 12. Air movement and ventilation control (AIVC) within buildings conference, Ottawa (Canada), 24-27 Sep 1991). Order Number DE93794741. Source: OSTI; NTIS.

Modern inlet devices applied in the field of ventilation of rooms are getting more complex in terms of geometry in order to fulfill the occupants' demand for thermal comfort in the room and in order to decrease the energy consumption. This expresses the need for a more precise calculation of the flow field. In order to apply computational fluid dynamics for this purpose it is essential to be able to model the inlet conditions precisely and effectively, in a way which is comprehensible to the manufacturer of inlet devices and in a way which can be coped with by the computer. In this paper a universal method is presented and tested. The method is based upon three-dimensional - and radial wall jet theory and upon diffuser specific experimental data. Simulations are held up against a more basic method and full-scale measurements. The inlet model is evaluated in terms of result, computational effort and applicability. Promising results are obtained. (au) (15 refs.).

23797 (AUC-IBT-R–9150) **Numerical investigation of transitional flow over a backward facing step using a low reynolds number K - ϵ model.** Indoor Environmental Technology Paper, 22. Skovgaard, M.; Nielsen, P.V. Aalborg Universitetscenter (Denmark). Inst. for Bygningsteknik. Dec 1991. 11p. (CONF-9109312–3: 12. Air movement and ventilation control (AIVC) within buildings conference, Ottawa (Canada), 24-27 Sep 1991). Order Number DE93794740. Source: OSTI; NTIS.

Recent full-scale experiments have detected the presence of low Reynolds' number effects in the flow in a ventilated room. This means that one is unable to predict the flow patterns in some geometries for air change rates - or Reynolds' numbers - which are relevant to ventilation engineering by a standard model of turbulence. In this paper it is investigated if it is possible to simulate and capture some of the low Reynolds number effects numerically using time averaged momentum equations and a low Reynolds number k-ϵ model. The test case is the laminar to turbulent transitional flow over a backward facing step with expansion ratio (h/H = 1/6). The results are evaluated and held up against experimental LDA data and data from a simulation with a Reynolds stress model (RSM). (au) (16 refs.).

23798 (CONF-9209231–2) **Cooling energy performance and installation of a retrofitted exterior insulation and finish system on masonry residences in the southwestern United States.** Ternes, M.P.; Wilkes, K.E.; McLain, H.A. Oak Ridge National Lab., TN (United States). [1992]. 19p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From International symposium on exterior insulation and finish systems; Arlington, VA (United States); 21-24 Sep 1992. Order Number DE93011844. Source: OSTI; NTIS; GPO Dep.

A field test involving eight single-family houses was performed during the summer of 1991 in Scottsdale, Arizona to evaluate the potential of reducing air-conditioning electricity consumption and demand by insulating their exterior masonry walls using a site-fabricated (non-commercially available) insulation and finish system. The exterior insulation system developed for the field test was easily performed and should result in a durable installation. Total per house costs to perform the installations ranged from $3610 to $4550. The average annual savings was estimated to be 491 kWh, or 9% of pre-retrofit consumption. Peak demands without and with insulation on the hottest day of an average weather year for Phoenix were estimated to be 4.26 and 3.61 kill, for a demand reduction of 0.65 kill (15%). We conclude that exterior masonry wall insulation offers the greatest potential for air-conditioning electricity savings and peak demand reductions in hot, dry climates similar to that of Phoenix. Retrofit economics need to be thoroughly examined from societal, utility, and consumer perspectives and must consider other benefits such as space-heating energy savings and improved house value.

23799 (CONF-921275–, pp. 85-88) **Fire plume characteristics in an area where a vertical down-flow exists.** Oka, Y. (Yokohama National University, Yokohama (Japan). Faculty of Engineering); Sukawa, O. 2 Dec 1992. 160p. (In Japanese). From 25. safety engineering study meeting; Kitakyushu (Japan); 2-3 Dec 1992. In *Proceedings of the 25th Safety Engineering Study Meeting.* Order Number DE93793904. Source: OSTI; NTIS (US Sales Only).

A vertical laminar air flow type clean room was taken up as an area where an air conditioning down-flow exists, and a fire was assumed to have broken out in such an area to investigate properties of plumes formed over a simulated fire source, especially their horizontal distribution. The experiment was carried out in a room with a floor area of 3.8 m^2 and a ceiling height of 3 m, in which the air conditioning flow is discharged uniformly from the entire surface of the ceiling and sucked into the whole surface of the floor. The down-flow rates were 25 cm/s and 45 cm/s. A circular fire source of 100 mm to 200 mm was installed on the center of a room, and supplied with methanol so that the liquid height is maintained constant during the measurement. Measuring temperatures and heated air rising velocities provided the following findings: The plume over the fire source has spread more horizontally than the plumes in free air spaces, but its horizontal distribution satisfies the Gaussian distribution. The plume temperature range did not agree with the velocity range in a flow field where the air conditioning down-flow exists, but the temperature range has surpassed. 8 refs., 3 figs.

23800 (CONF-921275–, pp. 147-148) **Evaluation on performance of fire property identifying system.** Koseki, D. (Fire Research Institute, Tokyo (Japan)); Sato, K.; Tamura, H.; Hosokawa, M.; Nomura, J.; Kurio, T.; Nakanishi, S. 2 Dec 1992. 160p. (In Japanese). From 25. safety engineering study meeting; Kitakyushu (Japan); 2-3 Dec 1992. In *Proceedings of the 25th Safety Engineering Study Meeting.* Order Number DE93793904. Source: OSTI; NTIS (US Sales Only).

An evaluation was given on non-fire alarm reduction effect of a fire property identifying system, using smoke sensor signals on non-fire alarm data-base collected in buildings. The system consists of a composite sensor integrating smoke, temperature, and CO gas sensors, a person-in-room detection sensor (PIR sensor), and a signal processing device. If event data are input on a non-fire alarm or a pre-alarm due to steam, the system determined the data correctly as steam, and began operation within 60 seconds after a smoke sensor signal output began rising. In the case of a non-fire

alarm or a pre-alarm due to cigarette smoke, the system operated the PIR sensor or automatic telephone call judging the data as cigarette smoke if a person is in the room, and did not issue a non-fire alarm. The system was capable of discriminating 30 cases out of 43 non-fire alarm issuances due to steam and cigarette smoke generated by a hotel and its tenants, except for 13 cases of which cause was not made clear. It was found that non-fire alarms can be eliminated at least at 70%. 4 refs., 3 figs., 2 tabs.

23801 (CONF-921275–, pp. 149-152) **System to identify a person in room at fire using infrared sensor and telephone response system.** Hosokawa, M. (Fire Research Institute, Tokyo (Japan)); Sato, K.; Koseki, D.; Tamura, H.; Okuda, Y.; Kirihata, S. 2 Dec 1992. 160p. (In Japanese). From 25. safety engineering study meeting; Kitakyushu (Japan); 2-3 Dec 1992. In *Proceedings of the 25th Safety Engineering Study Meeting.* Order Number DE93793904. Source: OSTI; NTIS (US Sales Only).

This paper describes a summary and effectiveness of a system to identify a person in a room based on a human body infrared sensor and an automatic telephone response system. The experiment used a sensor installed on a ceiling to measure smoke concentration, temperature, and CO concentration in a flaming fire, a smoking fire on cotton sheets, steam, and cigarette smoke. The system had a fuzzy membership function using an output value from the human body infrared sensor as an input added to the cigarette smoke inferring part in a fuzzy expert system. The effectiveness of the prototype person-in-room identifying system on the fire property identifying system was proved when the system identified accurately smokes from the smoking fire and cigarettes. The telephone response system works in such a manner that if the result of an inference is a fire, the system rings automatically a telephone set in a room where an anomaly has occurred in the sensor level to give an evacuation information to a person in the room. In the event of issuing a non-fire alarm, if presence of an anomaly is responded, the inference result can be changed to a fire. Future development is required of a human body infrared sensor that can identify reliably waver of a flame and movements of human bodies. 5 refs., 7 figs.

23802 (CONF-921275–, pp. 153-154) **Accessibility of smoke, heat and CO gas to three-element fire sensor.** Tamura, H. (Fire Research Institute, Tokyo (Japan)); Sato, K.; Kozeki, D.; Hosokawa, M.; Kusanagi, S.; Fujioka, T.; Watanabe, Y. 2 Dec 1992. 160p. (In Japanese). From 25. safety engineering study meeting; Kitakyushu (Japan); 2-3 Dec 1992. In *Proceedings of the 25th Safety Engineering Study Meeting.* Order Number DE93793904. Source: OSTI; NTIS (US Sales Only).

In order to find effectiveness of composite sensors including a CO sensor, an experiment was carried out on responsiveness of smoke, heat and CO gas sensors. When a cigarette and a cotton sheet were burned, the CO sensor issued an alarm earlier by three to eight minutes on the whole than the smoke sensor, but when an air conditioning on, both sensors took 22 to 23 minutes before issuing alarms. The heat sensor issued no alarm. When a cigarette alone was burned, only the CO sensor issued an alarm in about four minutes when located directly above the smoke source, and in 10 to 12 minutes when located two meters away from the smoke source. When the air conditioning was turned on, no sensors issued an alarm. When n-heptane and toluene were ignited, all the three sensors began responding after approximately the same lapse of time. When a dried Japanese beech lumber was heated, the CO and smoke sensors started responding at approximately the same time, but the heat sensor gave no response. The CO sensor may sometimes detect smoking condition in the early stage of a fire or cigarette smoldering condition, and respond more quickly than the smoke sensor. The CO sensor may be able to serve for guarding a larger area depending on CO diffusibility. 1 ref., 5 figs., 2 tabs.

23803 (CONF-921276–, pp. 231-234) **Application of TIO2 thin film photocatalyst: construction materials with deodorizing function.** Shinozaki, H. (Tokai University, Tokyo (Japan). School of Engineering); Nakamura, K.; Hasegawa, T.; Saito, T.; Ogawa, T.; Hashimoto, K.; Fujishima, A. 3 Dec 1992. 305p. (In Japanese). From 1992 Japan Solar Energy Society, Japan Wind Energy Association joint converence; Osaka (Japan); 3-4 Dec 1992. In *1992 JSES (Japan Solar Energy Society)/JWEA (Japan Wind Energy Association) Joint Conference.* Order Number DE93793955. Source: OSTI; NTIS (US Sales Only).

This paper describes an attempt of deodorization with a photocatalyst and its application to construction materials. A thin film coated with TiO2 sol was used as a photocatalyst. A reductive reaction occurs on the side not irradiated with light, and oxidative reaction occurs on the side irradiated with light. With TiO2, the oxidative reaction using holes progresses normally faster than the reductive reaction to oxidize, decompose, and deodorize odorous substances. An experiment was carried out on deodorizing acetoaldehyde using ultraviolet rays as a light source. The oxidative decomposition rate did not depend on concentrations of the substances. The stronger the light intensity, the faster the reaction rate. The reaction is rate-controlled by light energy. The higher the sintering temperature, and the thicker the film thickness, the more the oxidative decomposition. The effective light wave length is in a range from 300 nm to 380 nm, suggesting a possibility of the reaction even with the sunlight. Odorous gases in actual environments, of which concentrations are generally low, would be able to react sufficiently with somewhat weak light and get decomposed. Problems to be solved include improving the thin film strength and adhesion, and reducing the sintering temperature. 4 refs., 6 figs., 1 tab.

23804 (CONF-921276–, pp. 255-258) **Experimental studies on the thermal performance of lawn-soil covered roof. Part 2.: Comparison of results from experiments and simulations.** Ishihara, O. (Kumamoto University, Kumamoto (Japan)); Zhang, Q. 3 Dec 1992. 305p. (In Japanese). From 1992 Japan Solar Energy Society, Japan Wind Energy Association joint converence; Osaka (Japan); 3-4 Dec 1992. In *1992 JSES (Japan Solar Energy Society)/JWEA (Japan Wind Energy Association) Joint Conference.* Order Number DE93793955. Source: OSTI; NTIS (US Sales Only).

An environmental mitigation effect was studied by proposing an environmental computation model in case that the roof of building is covered with lawn and soil. Thermal balance was conceived of each of both air layer having leaves and lawn, and ground surface of soil. Thermal conduction was assumed to be one-dimensional in both soil and roof slab. Not influence of sunlight radiation but percolation heat only between the roof-space and outdoors was taken into consideration for the air layer in the roof-space. As a result of actual measurement, the air temperature in the roof-space was lower and fructuantly smaller than the conventional one, which was attributable to the evaporation effect of lawn, and large thermal capacity and low thermal conductivity. Thermal quantity flowing into the room was computed by using the environmental computation model. The thermal quantity flowing through the present lawn-soil (soil produced in Kumamoto) covered roof in summer was reduced to 65% of that through the conventionally insulated slab roof. When the soil was replaced by light weight artificial soil, the former quantity was further reduced to 26% of the latter one. Against the insulated slab roof, the lawn-soil covered roof and lawn-artificial soil covered roof saved air cooling energy by 7% and 15%, respectively on the top floor of building, and are therefore promising in effective mitigation of the environment. 4 refs., 9 figs.

23805 (CONF-921276–, pp. 259-262) **Study on the thermal performance of the passive air circulation house. Part 9: Comparison of the results from simulations and experiments.** Ishihara, O. (KUmamoto University, Kumamoto (Japan)); Tajima, M.; Hayashi, T. 3 Dec 1992. 305p. (In Japanese). From 1992 Japan Solar Energy Society, Japan Wind Energy Association joint converence; Osaka (Japan); 3-4 Dec 1992. In *1992 JSES (Japan Solar Energy Society)/JWEA (Japan Wind Energy Association) Joint Conference.* Order Number DE93793955. Source: OSTI; NTIS (US Sales Only).

Passive air circulation (PAC) house was verified in computation program for both fluctuations in room temperature and thermal load. As compared with the estimation through actual measurement, the air circulation in the building and thermal loss from the wall had been underestimated and overestimated, respectively through simulation. Then as a result of transition in condition by weakening the air resistance in the wall space and strengthening the air circulation, the values obtained through simulation could generally approximate those done through actual measurement. Comparative

computation in air heating load was made between the experimental PAC house and the conventional house which is equivalent to it in thermal insulation performance. The above experimental house saved 47.4% and 46.2% of the required energy for the conventional house in case of one-room house without partition and that divided into more or less six-mat rooms with partitions, respectively. The air heating load diminishes with partitioning the house into a certain number of rooms while the energy saving ratio heightens with making the rooms voluminous. Though future investigation will have to be made on the opening area and clearance-equivalent area of building, the present computation program is judged to be on the safety side for the air heating load. 3 refs., 4 figs., 3 tabs.

23806 (CONF-921276–, pp. 263-266) **Study on utilizing natural energy for indoor climate control using roof and attic space. Part 3.: Experimental analysis on the cooling performance by water flowing down on roof.** Ito, N. (Tokyo Metropolitan University, Tokyo (Japan)); Sunaga, N.; Komano, S. 3 Dec 1992. 305p. (In Japanese). From 1992 Japan Solar Energy Society, Japan Wind Energy Association joint converence; Osaka (Japan); 3-4 Dec 1992. In *1992 JSES (Japan Solar Energy Society)/JWEA (Japan Wind Energy Association) Joint Conference*. Order Number DE93793955. Source: OSTI; NTIS (US Sales Only).

Air cooling performance by water flowing down on the roof was studied to adjust the indoor hot heat environment of residential and other buildings. The air cooling is made on a heat-insulating surface of colored steel plate-tiled roof while the thermal collection is done by a heat-collecting panel in its attic space. As an air cooling experiment structure in summer, the previously tested prototype structure was modified by adding polystyrene foamed to a thickness of 50mm under the colored steel plate and making the water flow down with forming a wide film on the roof surface. To investigate the air cooling characteristics with exception of those influenced by the meteorological condition, regression was multiply made by using data from 1900 to 0500 hours having no radiation of solar light, and considering the thermal quantity of air cooling as an object function and dry/wet bulb temperature, wind velocity, etc. as explanatory functions. The thermal quantity of air cooling gave a relativity as high as 0.922 in relativity factor to the temperature differential between the water at inlet and wet bulb, which factor can be used for expressing the air cooling characteristics. Relatively to the above temperature differential of 2 centigrade, air cooling energy of about 250Wh was obtained, which reulted in generally doubling the air cooling characteristics given by the previously tested prototype structure. The cooling by rainfall is not negligible but able to be used as a cold heat source. 2 refs., 9 figs., 1 tab.

23807 (CONF-930427–2) **Gas fueled space conditioning heat pump research in the United States.** Myers, G.H. (Gas Research Inst., Chicago, IL (United States)); Freedman, S.I.; French, C.E.; DeVault, R.C. Oak Ridge National Lab., TN (United States). [1993]. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 4. International Energy Agency heat pump conference: heat pump for energy efficiency and environmental progress; Maastricht (Netherlands); 26-29 Apr 1993. Order Number DE93011856. Source: OSTI; NTIS; GPO Dep.

Both gas-engine-driven mechanical vapor compression and gas fuel thermally activated sorption space conditioning heat pump technologies are under development in the United States. The residential 3RT gas-engine heat pump has successfully completed a 10 unit field test and is entering a 50 unit field demonstration phase supported by the manufacturers and the gas industry in the endeavor to commercialize this new HVAC technology. Several sorption technologies, including absorption, adsorption, and chemisorption of ammonia vapor are in various stages of development. Prototype ammonia-water absorption GAX systems have been built and tested in the laboratory with expectations of entering a field test in 1993. Solid-vapor, ammonia-carbon, and ammonia-salt systems are in laboratory system development and bench scale component development stages respectively. All face economic trade-off issues regarding cost and performance.

23808 (DOE/CE/15382–T2) **[Waste water heat recovery system]: Final report, September 30, 1992.** Smart Drain, Inc., Farmingdale, NY (United States). 28 Apr 1993. 22p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG01-89CE15382. Order Number DE93013234. Source: OSTI; NTIS; GPO Dep.

The production capabilities for and field testing of the heat recovery system are described briefly. Drawings are included.

23809 (DOE/CE/15407–T13) **Extended range tankless water heater: Final technical report.** Harris, J.A. Harmony Thermal Co., Inc., Greeley, CO (United States). 18 Apr 1993. 33p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG01-89CE15407. Order Number DE93013327. Source: OSTI; NTIS; GPO Dep.

In this research program, a laboratory test facility was built for the purpose of testing a gas-fired water heating appliance. This test facility can be used to examine the important performance characteristics of efficiency, dynamic response, and quality of combustion. An innovative design for a tankless water heater was built and then tested to determine its performance characteristics. This unit was tested over a 5:1 range in input (20,000 to 100,000 btuh heat input). The unit was then configured as a circulating hot water boiler, and a specially designed heat exchanger was used with it to generate domestic hot water. This unit was also tested, and was found to offer performance advantages with regard to low flow and temperature stability.

23810 (DOE/CE/23810–7) **Theoretical evaluation of R22 and R502 alternatives: Final report.** Domanski, P.A. (National Inst. of Standards and Technology (NEL), Gaithersburg, MD (United States). Building Environment Div.); Didion, D.A. Air-Conditioning and Refrigeration Technology Inst., Inc., Arlington, VA (United States); National Inst. of Standards and Technology (NEL), Gaithersburg, MD (United States). Building Environment Div. Jan 1993. 26p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-91CE23810. Order Number DE93014767. Source: OSTI; NTIS; GPO Dep.

The study was conducted using a semi-theoretical model, CYCLE-11, with a pure cross-flow representation of heat transfer in the evaporator and condenser. The Carnahan-Starling-DeSantis equation of state was used for calculating thermodynamic properties. Transport properties were not involved in the simulations. Simulations were conducted for "drop-in" performance, for performance in a modified system to assess the fluids' potentials, and for performance in a modified system equipped with a liquid-line/suction-line heat exchanger. The results - presented on a relative basis to R22 and R502 performance - include the volumetric capacity, coefficient of performance, pressure increase across the compressor, and compressor discharge pressure and temperature.

23811 (DOE/ER/60547–5) **Measurement and apportionment of radon source terms for modeling indoor environments: Final progress report, March 1990–August 1992.** Harley, N.H. New York Univ. Medical Center, NY (United States). Dept. of Environmental Medicine. 1992. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-87ER60547. Order Number DE93013976. Source: OSTI; NTIS; INIS; GPO Dep.

During the present 2 1/2 year contract period, we have made significant Progress in modeling the source apportionment of indoor ^{222}Rn and in ^{222}Rn decay product dosimetry. Two additional areas were worked on which we believe are useful for the DOE Radon research Program. One involved an analysis of the research house data, grouping the hourly house ^{222}Rn measurements into 2 day, 7 day and 90 day intervals to simulate the response of passive monitors. Another area requiring some attention resulted in a publication of 3 years of our indoor/outdoor measurements in a high-rise apartment. Little interest has been evinced in apartment measurements yet 20% of the US population lives in multiple-family dwellings, not in contact with the ground. These data together with a summary of all other published data on apartments showed that apartments have only about 50% greater ^{222}Rn concentration than the measured outdoor ^{222}Rn. Apartment dwellers generally represent a low risk group regarding ^{222}Rn exposure. The following sections describe the main projects in some detail.

23812 (DOE/FTR–93012813) **Participation in conferences concerning the use of computers in the energy/architecture design process: Foreign trip report, August 11–September 3,**

1992. Brown, G.Z. (Oregon Univ., Eugene, OR (United States). Dept. of Architecture). Pacific Northwest Lab., Richland, WA (United States). 24 Sep 1992. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93012813. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The trip was in support of the Advanced Energy Design and Operating Technology and Energy Efficient Industrialized Housing research projects. A broad range of comment was obtained on information presented on these projects. The general direction of projects was confirmed by other researchers. Some valuable detailed changes were suggested. Two conferences, two universities, two research institutes and several building sites were visited. Opportunities for collaboration were discovered at three locations. A new waste material foam product was discovered and will be evaluated for testing in our stressed skin panel project. Transparent insulation will be evaluated for use in US industrialized housing, based on the experience of Dutch researchers.

23813 (LBL–33404) **Luminance in computer-aided lighting design.** Ward, G.J.; Rubinstein, F.M.; Grynberg, A. Lawrence Berkeley Lab., CA (United States). Aug 1987. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. (CONF-890615–4: Building simulation '89, Vancouver (Canada), 23-24 Jun 1989). Order Number DE93010458. Source: OSTI; NTIS; GPO Dep.

Traditionally, the lighting engineering community has emphasized illuminance, the amount of light reaching a surface, as the primary design goal. The Illuminating Engineering Society (IES) provides tables of illuminances for different types of tasks which lighting engineers consult in designing lighting systems. Illuminance has proven to be a popular metric because it corresponds closely to the amount of energy needed to light a building as well as the initial cost of the lighting system. Perhaps more importantly, illuminance is easy to calculate, especially in simple unobstructed spaces with direct lighting. However,illuminance is not well correlated with visual performance, which is the real reason for installing a lighting system in the first place. Visual performance is a psychophysiological quantity that has been tied to physical quantities such as contrast, size and adaptation level by subject experiments. These physical quantities can be approximated from illuminance using a host of assumptions about the environment, or derived directly from the distribution of luminance. Luminance is the quantity of light traveling through a point in a certain direction, and it is this quantity that the eye actually "sees". However, the difficulty of calculating luminance for common tasks has made it an unpopular metric. Despite its importance to lighting design, luminance is rarely used because there is a lack of the necessary computational tools.In this paper, we will demonstrate a computer calculation of luminance that has significant advantages for lighting design. As well as providing an immediate evaluation of visual quality for task performance, less quantifiable factors such as aesthetics can be studied in synthetic images produced by the program.

23814 (NEI-DK–1130) **Low-energy window panes with the heat-reflecting film coating "heat mirror": Demonstration project and production potentials in Denmark.** Boye Olesen, G.; Staal Paulsen, O. Koebenhavns Miljoe- og Energikontor, Copenhagen (Denmark); Four Seasons, Kolding (Denmark). Feb 1993. 17p. (In Danish). Contract ENS-UVE-89.0618. Order Number DE93794678. Source: OSTI; NTIS.

A new type of low-energy double glazed window is now on the Danish market. It consists of two panes with a heat reflecting film between then. A type of film manufactured in California ("Heat Mirror") and another made in Japan (Reftel film) are investigated. These films and their uses are described in detail and relevant data on heat losses, U-values, light transmittance, measurements etc. are given. A report is presented from two demonstration houses with double glazed windows fitted with "Heat Mirror". An inhabitant claims that these windows save as much energy as other double glazed window types. Investment costs vary in relation to types of household heating systems. A individual house owner can pay twice as much as another person living in a housing cooperative connected to the district heating system in Copenhagen. An overview is given of work done until now to promote production of this type of window in Denmark, and necessary actions to take in order to establish this production. (AB).

23815 (NEI-DK–1141) **The way to lower electricity consumption: Saving electricity in the homes of Danish consumers.** Viegand, J. (ed.). ARKE, Aarhus (Denmark); BHHH, Horsens (Denmark); EASV, Skaerbaek (Denmark); HEF, Aalborg (Denmark); KOH, Kolding (Denmark); Danmarks Naturfredningsforening, Copenhagen (Denmark); Danmarks Tekniske Hoejskole, Lyngby (Denmark). Fysisk Lab. 3. Dec 1992. [98p.] (In Danish). Contract ENS-51191-91.0055. Order Number DE93794676. Source: OSTI; NTIS.

The aim was to demonstrate how households can lower their consumption of electricity by changing their habits and substituting their old electrical appliances for new and better ones. A group of 100 families was trained in good habits related to electricity use and another group of 20 families not only received the same training but were also enabled to change out their electric appliances. The annual electricity consumption was measured throughout one year in the case of each family. Results showed that the first group had reduced consumption by 12% and the second by 47%. The second group saved most on refrigerators and deep freezers and on other appliances which needed lights. Here the saving was 59%-66%. In the case of washing and washing up machines the saving was 40% and 37% respectively. Saving on clothes-drying machines amounted to a reduction of 9%, on cookers 18% and on central-heating boilers, circulation pumps and electric water heaters 33%. It was shown that it was possible to grow into the habit of saving energy and also to sustain these habits without lowering the level of comfort, that daily meter reading was promotive to electricity saving habits and that low-energy electric bulbs aided conservation. Electricity-saving habits can be stimulated by measuring temperatures in refrigerators etc. and significant reduction in consumption can be obtained by substituting electrical appliances for more energy-efficient models. (AB).

23816 (ORNL/CON–333) **Research update, existing buildings research, 1989–1991.** MacDonald, J.M. (Oak Ridge National Lab., TN (United States)); Ternes, M.P.; Mixon, W.R.; Sharp, T.R.; Kolb, J.O.; Wilkes, K.E.; Diamond, R.C.; Judkoff, R.; Mazzucchi, R.P. Oak Ridge National Lab., TN (United States). Feb 1993. 77p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93012517. Source: OSTI; NTIS; GPO Dep.

This Research Update presents the status of the Existing Buildings Research program of the Office of Building Technologies of the US Department of Energy for the period 1989-199 1. This program covers research on energy efficiency improvements for the residential and commercial buildings in this country. ne Existing Buildings Research program has contributed to significant improvements in energy efficiency of existing buildings by development of improvements to retrofit technologies, by coordinating and conducting research studies on the use of energy efficiency technologies (to reduce barriers and increase use), and by continually evaluating changes in technologies that could improve and maintain buildings energy efficiency. If the energy efficiency of the buildings sector in this country is to be dramatically improved over the next 30 years, we must improve the use of energy efficiency technologies. Improved delivery of measures, improved understanding of how buildings actually perform in the field, and methods for improving operations and maintenance of buildings and energy equipment are all examples of ways to improve the deployment (transfer) of technologies. Much has been learned about technology deployment in buildings in the first five years of the program, and our future plans will be directed at continuing the improvements and making a real contribution to the energy efficiency future of the United States.

23817 (PNL–8616) **User's guide for ENVSTD24 program, Version 2.4.** Hanlon, R.L.; Connell, L.M. Pacific Northwest Lab., Richland, WA (United States). May 1993. 45p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93014185. Source: OSTI; NTIS; GPO Dep.

On January 30, 1989, the US Department of Energy (DOE) promulgated an interim rule entitled "Energy Conservation Voluntary Performance Standards for New Commercial and Multi-Family High

Rise Residential Buildings; Mandatory for New Federal Buildings" (10 CFR Part 435, Subpart A). These standards require federal agencies to design all future federal commercial and multifamily high-rise residential buildings in accordance with the standards, or demonstrate that their current requirements already meet or exceed the energy-efficiency requirements of the standards. Although these newly enacted standards do not regulate the design of nonfederal buildings, the DOE recommends that all design professionals use the standards as guidelines for designing energy-conserving buildings. To encourage private sector use, the DOE published the standards in the January 30, 1989, Federal Register in the format typical of commercial standards. The Pacific Northwest Laboratory developed several computer programs for the DOE to make it easier for designers to comply with the standards. One of the programs, ENVSTD24 (Version 2.4), is detailed in this user's guide and is provided on the accompanying diskettes. The program will facilitate the designer's use of the standards dealing specifically with building envelope design. Using this program will greatly simplify the designer's task of performing the calculations needed to determine if a design complies with the standards.

23818 (PNL-SA–22157) **AEDOT technology.** Shankle, D.L. Pacific Northwest Lab., Richland, WA (United States). Mar 1993. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93012866. Source: OSTI; NTIS; GPO Dep.

Most commercial buildings designed today will use more energy and cost more to operate and maintain than necessary. If energy performance were considered early in building design, 30% to 60% of the energy now used in new commercial buildings could be saved cost-effectively. However, most building design teams do not adequately consider the energy impacts of design decisions to achieve these savings; the tools for doing so simply do not yet exist. Computer technology can help design teams consider energy performance as an integral part of the design process. This technology could enable designers to produce much more energy-efficient buildings without increasing the costs of building design. Recognizing this, the US Department of Energy (DOE) has initiated the Advanced Energy Design and Operation Technologies (AEDOT) project, led by Pacific Northwest Laboratory (PNL). The aim of the project is to develop advanced computer-based technologies that will help designers take advantage of these potentially large energy savings. The success of the AEDOT project depends largely on the ability to develop energy design-support tools that can be integrated into comprehensive building design environments so that all parts of the design process willbe supported. Energy, just one consideration among many in building design, must be considered in a context that includes visual, acoustic, and structural aspects; accessibility; thermal comfort; indoor air quality; cost; and other factors associated with the quality, acceptability, and performance of a building. Advanced computer-aided design support environments will need to integrate tools from many different domains and provide access to the vast amounts of data that designers need to apply these tools and to make informed decisions.

23819 (SAND–92-2270C) **What is IAQ.** Huff, G. Sandia National Labs., Albuquerque, NM (United States). [1992]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-9306159–1: 1993 Society of Women Engineers (SWE) conference, Chicago, IL (United States), 21-27 Jun 1993). Order Number DE93012349. Source: OSTI; NTIS; GPO Dep.

Does indoor air quality (IAQ) affect you? The answer is an emphatic YES! Problems affecting indoor air quality can range from a stinky rest room to Sick Building Syndrome. IAQ goes beyond avoiding odors through sufficient ventilation. Many health issues are also involved. IAQ problems are generally complex with no single source causing them. Rather, they result from a combination of several sources that require an organized, but flexible, plan of attack. The purpose of this paper is to define the terms associated with the subject of IAQ, provide some history on the subject, and finally describe my experiences with the continuing process of assessing and remediating problems associated with poor indoor air quality in a new laboratory building.

23820 (TTKK-JULK–87) **Thermal analysis of buildings - verification and further development of the TASE program.** Kalema, T. Tampere Univ. of Technology (Finland); National Board of Waters and the Environment, Helsinki (Finland). Environmental Data Centre. 1992. 185p. Order Number DE93794776. Source: OSTI; NTIS.

The TASE program, which is a transient multiroom model for the thermal analysis of buildings, is verified using both laboratory measurement data and the internationally well-known DOE, ESP and SERIRES programs. In the former of these the average room air temperatures, surface temperatures and values of wall heat flux for a step change in radiator power, and in the latter the peak heating and cooling loads and annual energies, employing Denver as well as Memphis (USA) weather data, are compared. The accuracy of the thermal analysis is improved by taking into account variations in interior convective and radiative heat transfer coefficients and the transient multidimensional heat transfer for a ground slab. Energy savings using transparent insulation on exterior walls in Finnish climate conditions are studied using a model in which the transparent insulation is treated as an effective absorption coefficient for which an equation is derived.

23821 (TTKK/LT–68) **Absorption heat pumps in heating and cooling systems.** Aittomaeki, A.; Vaelimaeki, A.; Koepsi, M. Tampere Univ. of Technology (Finland). Thermal Engineering. 1989. 70p. (In Finnish). Order Number DE93794784. Source: OSTI; NTIS.

LVIS 2000 Research Programme.

The application of an absorption heat pumps as the heating and cooling system of an office building has been studied by means of a simulation model, designed for this application purpose. The effects of an absorption heat pump on emissions that are harmful to the environment depend on the fuel used. If the fuel is lightweight oil or gas, the sulphur and particle emissions diminish, but NO_x and hydrocarbon emissions may increase as the combustion units become smaller. The use of an absorption heat pump reduces CFC emissions because other refrigerants are used in an absorption heat pump.

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Refer also to citation(s) 23223, 23224, 23839, 23919, 23920, 24136, 24252, 24253, 24254

23822 (NAL-TM–647) **Investigation on the effectiveness of the piping interference removal system for STOL aricraft wind tunnel tests.** Takahashi, H. (National Aerospace Laboratory, Tokyo (Japan)); Nakaya, T.; Noguchi, M.; Nonaka, O.; Hoshino, H.; Inoue, T. National Aerospace Lab., Chofu, Tokyo (Japan). Apr 1992. 25p. (In Japanese). Order Number DE93793614. Source: OSTI; NTIS; Available from National Aerospace Laboratory, 44-1, Shindaiji Higashicho 7-chome, Chofu-City, Tokyo, Japan.

A wind tunnel test on a powered model using high-pressure air generates interference force from pressure piping, acting on a balance. A device was developed to reduce this interference force using the principle of an air bearing. This device utilizes an air joint inserted with triple cylinders with rotation centers eccentric with each other. Upon having verified that the device reduces the interference force with good reproducibility, wind tunnel experiments were carried out that included such test items as α, β continuous sweep reproducibility, supply air variation reproducibility, equivalent pattern reproducibility, and comparison with the conventional rubber hose system. From the test result, such advantages were discovered that the device has little piping interference force, eliminates a need of piping interference correction, can repeat the α, β sweep continually, and improves symmetry during a β-sweep. Disadvantages include necessity of a skill foroperation, susceptibility to environmental conditions, and high supply air pressure, but all of them would be possible to be solved. 9 refs., 28 figs., 2 tabs.

23823 (NAL-TR–1145) **Estimation of the attitude motion of the small satellite "ORIZURU".** Nakajima, A. (National Aerospace Laboratory, Tokyo (Japan)); Terui, F.; Ishii, K.; Habe, H. National Aerospace Lab., Chofu, Tokyo (Japan). Apr 1992. 28p. (In Japanese). Order Number DE93793616. Source: OSTI; NTIS; Available

from National Aerospace Laboratory, 44-1, Shindaiji Higashicho 7-chome, Chofu-City, Tokyo, Japan.

An estimation was made on the in-orbit attitude motion of the small engineering experimental satellite 'ORIZURU'. Attitude data are provided only from the satellite's sun sensors. To estimate the attitude motion, the flight data were compared with numerical simulation results, and parameters with coinciding patterns were sought. The attitude motion is estimated as follows: The spin cycle grew longer at a certain rate as the time elapses (decrease in spin angular speed), the time of 41.5 seconds at the beginning varies at a rate of 0.89 sec/d. Major cause for this phenomenon should be the influence from eddy current. Lateral moment at separation from the rocket generates nutation whose angle is 52.1 degrees. The sun angle varies largely in the simulation. This should be because of actions of disturbance torques such as eddy current torques. The spin cycle change was extrapolated, where the spin cycle immediately after separation from the rocket was estimated 39.7 seconds. From this value, the external force imposed from the spring at the separation was calculated 0.66 Nms for axis circumference and 0.84 Nms for perpendicular axis circumference. 4 refs., 12 figs., 3 tabs.

23824 (NAL-TR–1165) **In-orbit performance tests and telecommand systems of the umbrella test satellite (DEBUT).** Kumagai, T. (National Aerospace Laboratory, Tokyo (Japan)); Nakajima, A.; Sakurai, Y. National Aerospace Lab., Chofu, Tokyo (Japan). Jun 1992. 25p. (In Japanese). Order Number DE93793624. Source: OSTI; NTIS; Available from National Aerospace Laboratory, 44-1, Shindaiji Higashicho 7-chome, Chofu-City, Tokyo, Japan.

This paper reports on the command control system, the telemetry analytic system and the space experiment operation in DEBUT (Deployable Boom and Umbrella Test Satellite). The experimental devices are divided largely into a command control device to operate the mission system of the satellite, and a telemetry analytic device to analyze data for a bus condition or a mission condition. The former device consists of a computer and a command generator. Programs for the latter device has enough room for real-time data processing and display. These devices had relatively simple construction, but the reliability was so high that none of them has developed a malfunction. Because the space experiments were completed earlier than the schedule, some more experiment modes were added. No problems were experienced in interface of the ground station facilities with the command control and telemetry analysis systems. An erroneous interpretation has occurred on the satellite in a command signal because of a cyclic fading in an orbit with a low satellite elevation angle, but the malfunction determining program performed a retransmission by which a correct command was executed. 4 refs., 15 figs., 14 tabs.

23825 (NEI-DK–1151) **Energy consumption by the private and commercial vehicles, and by public transport facilities, which comprise urban street traffic.** Cowiconsult Raadgivende Ingenioerer A/S, Lyngby (Denmark). Mar 1993. 77p. (In Danish). Contract ENS-1243/91-0003. Order Number DE93794691. Source: OSTI; NTIS.

EFP-91.

The aim was to compare the energy consumption by private and commercial vehicles with that of public transport facilities constituting urban street traffic, and to evaluate the influence of various traffic related plans such as green waves (where cars are able to drive through the town with relatively few accelerations and braking) streets with lower speed limits and special lanes and priorities for buses. The traffic pattern in four Copenhagen streets (Jagtvej, Soelvgade, Bredgade and Strandvejen) were measured and analyzed both in, and not in, the rush hour, and a special model was used to calculate the energy consumption. The model defines degree of acceleration and slow-down and speed when calculating energy consumption with regard to various driving patterns. It also calculates carbon dioxide emission. It was found that energy consumption decreased with increasing driving speed at 10-60 km/h for all vehicles. The case of buses is a little different because of having to stop so frequently. Bus lanes decrease the number of stops because of traffic situations, but do not seem to result in energy savings. These lanes decrease space for other vehicles which can result in more pollutive emission. When buses are not required to stop at traffic lights (because of bus lane innovation), energy is saved to the amount of 5-10%. An evenness of traffic flow can reduce energy consumption by 10% (Soelvgade), 20% (Bredgade) and 35-40% (Soelvgade and Jagtvej). It is concluded that the use of bus lanes and bus priorities results in greater energy saving in the case of private cars because of the irregularity of bus driving patterns. (AB).

23826 (NEI-DK–1169) **Freight transport in towns: Main report.** Cowiconsult Raadgivende Ingenioerer A/S, Lyngby (Denmark). Oct 1992. 122p. (In Danish). Contract ENS-1243/91-0001. Order Number DE93794745. Source: OSTI; NTIS.

EFP-91.

The aim was to evaluate a number of possibilities for reducing energy consumption and thus air pollution caused by freight transport in urban areas. The Danish towns of Vejle and Roskilde were taken as examples and the two towns were compared with regard to the town plan, use of land area, the road network, amount of traffic and commercial structure. Economical aspects and the most important initiatives for improvements, including a decrease in traffic accidents, are discussed. These initiatives are coordination of transportation by firms, more drivers using the same vehicles, less frequent deliveries, optimazation of route planning, car sharing, special routes for lorries, traffic and speed control, better siting of new transport functions, re-siting of firms dependent on freight transport, the use of smaller vehicles where possible, no transport of people in trucks or vans, less use of bicycles for transporting messages, more use of underground pipes for transport of materials, lifting equipment for smaller vans and trucks, lifting equipment that is more flexible, motors turned off when loading and loading, reduction of emballage volume, and a more careful way of driving which can help to reduce energy consumption. A computer programme was constructed in order to calculate energy consumption in these relations, emission of hydrocarbons, carbon monoxide, nitrogen oxides and particles, transportation costs and number of traffic accidents. Results are presented in detail and discussed. (AB) (78 refs.).

23827 (NEI-DK–1170) **Freight transport in towns: Summary report.** Cowiconsult Raadgivende Ingenioerer A/S, Lyngby (Denmark). Apr 1993. 33p. (In Danish). Contract ENS-1243/91-0001. Order Number DE93794758. Source: OSTI; NTIS.

EFP-91.

The aim of the project was to determine possibilities for making freight transport in towns efficient and to reduce the negative effects on the urban environment of this type of road transport. The Danish towns of Vejle and Roskilde were chosen for investigation and comparison. This publication summarizes results reached in the main report of the same title. After a short general summary of the project methods the resulting recommendations are presented in detail in the form of schemes, each presenting a more detailed description of the recommendation, ideas for a possible spreading of the initiative to cover a larger area of freight transport, and some notes on implementation. The effect in each case is illustrated in the form of a graph showing amount of energy saving, reduction in hydrocarbon, nitrogen oxides, carbon monoxide and particle emission, and reduction in transport economy and traffic accidents. (AB).

23828 (NREL/TP–432-4882) **Non-CFC air conditioning for transit buses.** Pesaran, A.A.; Parent, Y.O.; Bharathan, D. National Renewable Energy Lab., Golden, CO (United States). Nov 1992. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-83CH10093. Order Number DE93000033. Source: OSTI; NTIS; GPO Dep.

In the United Sates, more than 80% of transit city buses are air conditioned. Vapor compression refrigeration systems are standard for air conditioning buses and account for up to 25% of fuel consumption in the cooling season. Vapor compression devices use chlorofluorocarbons (CFCs), chemicals that contributes to Earths's ozone depletion and to global warming. Currently, evaporative cooling is an economical alternative to CFC vapor compression refrigeration for air conditioning buses. It does not use CFCs but is restricted in use to arid climates. This limitation can be eliminated

by dehumidifying the supply air using desiccants. We studied desiccant systems for cooling transit buses and found that the use of a desiccant-assisted evaporative cooling system is feasible and can deliver the required cooling. The weight and the size of the desiccant system though larger than vapor compression systems, can be easily accommodated within a bus. Fuel consumption for naming desiccant systems was about 70% less than CFC refrigeration system, resulting in payback periods of less than 2.5 years under most circumstances. This preliminary study indicated that desiccant systems combined with evaporative cooling is a CFC-free option to vapor compression refrigeration for air conditioning of transit buses. The concept is ready to be tested in a fun prototype scale in a commercial bus.

23829 (ORNL–6743) **Transportation energy data book: Edition 13.** Davis, S.C.; Strang, S.G. Oak Ridge National Lab., TN (United States). Mar 1993. 335p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93013846. Source: OSTI; NTIS; GPO Dep.

The Transportation Energy Data Book: Edition 13 is a statistical compendium prepared and published by Oak Ridge National Laboratory (ORNL) under contract with the Office of Transportation Technologies in the Department of Energy (DOE). Designed for use as a desk-top reference, the data book represents an assembly and display of statistics and information that characterize transportation activity, and presents data on other factors that influence transportation energy use. The purpose of this document is to present relevant statistical data in the form of tables and graphs. Each of the major transportation modes – highway, air, water, rail, pipeline – is treated in separate chapters or sections. Chapter 1 compares US transportation data with data from seven other countries. Aggregate energy use and energy supply data for all modes are presented in Chapter 2. The highway mode, which accounts for over three-fourths of total transportation energy consumption, is dealt with in Chapter 3. Topics in this chapter include automobiles, trucks, buses, fleet automobiles, federal standards, fuel economies, and vehicle emission data. Household travel behavior characteristics are displayed in Chapter 4. Chapter 5 contains information on alternative fuels and alternatively-fueled vehicles. The last chapter, Chapter 6, covers each of the nonhighway modes: air, water, pipeline, and rail, respectively.

23830 (UCRL-JC–109420) **Compatibility specifications for AVI equipment in California.** Davis, D. (Lawrence Livermore National Lab., CA (United States)); Dunn, D.; Jelsma, L.; Blum, A.; Kubel, L.; Winter, W.; Pinkerman, K.; Rounds, R. Lawrence Livermore National Lab., CA (United States); California State Dept. of Transportation, Sacramento, CA (United States). Div. of New Technology, Transporation Materials and Research. Jan 1992. 8p. Sponsored by California State Government, Sacramento, CA (United States). DOE Contract W-7405-ENG-48. (CONF-9206335–3: International symposium on automotive technology and automation, Florence (Italy), 1-5 Jun 1992). Order Number DE93012486. Source: OSTI; NTIS; GPO Dep.

This paper presents an overview of the functional and technical specifications recently developed in California for automatic vehicle identification (AVI) systems. The goal is to ensure compatibility between systems implemented throughout California by various toll authorities for electronic toll collection. A secondary goal is to structure the specifications to enable upward compatibility of these systems for applications beyond toll collection such as IVHS while minimizing costs by encouraging vendor competition. Both of these objectives were achieved. The AVI compatibility specifications were developed around the two principal system elements; the toll agency reader and the on-vehicle transponder. The specifications call for two-way communications between these elements with user defined message formats. This permits a number of important options including non-interference with other systems, data encryption for account security, transaction verification, and write to transponder options such as toll road intransit data and account balance updating. The role of the reader is (1) to wake up or fully activate a vehicle transponder within its domain of influence, (2) to pole the transponder requesting specific information, and (3)to provide an acknowledge message after receiving a valid transponder response. The transponder's role is to interpret the polling message from the reader and respond as appropriate. The intent of our effortswas not to specify an AVI system design but rather to establish over-the-air communication protocols. However, some hardware related decisions had to be made. One such choice was the selection of modulation backscatter for transponder signaling rather than using an active RF source. This places frequency control and precision in the hands of the reader where we felt it should be.

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Refer also to citation(s) 22685, 22687, 22688, 22741, 23255, 23277, 23332, 23690, 23738, 23753, 23763, 23788, 23808, 23809, 23874, 24115, 24265, 24266, 24268, 24575, 24659, 24742, 24938, 24974

23831 (CONF-921275–, pp. 123-126) **Decomposition treatment of organic chlorine compounds by means of high-temperature melts utilizing nucleophilic desplacment reaction.** Sakai, Y. (Yokohama National University, Yokohama (Japan). Faculty of Engineering); Yazawa, T.; Asakura, S. 2 Dec 1992. 160p. (In Japanese). From 25. safety engineering study meeting; Kitakyushu (Japan); 2-3 Dec 1992. In *Proceedings of the 25th Safety Engineering Study Meeting.* Order Number DE93793904. Source: OSTI; NTIS (US Sales Only).

While disposition of organic chlorine compounds that present environmental destruction problems uses incineration, this paper pursues a possibility of high-rate decomposition at lower temperature than in an incineration process, by means of high-temperature melts. Dichloromethane, choloroform, and carbon tetrachloride (hereinafter referred to as A, B, and C, respectively) were used as test samples, which were introduced into a reaction container as a nitrogen gas mixture with concentrations from 15% to 20%. The reaction container charged with 20 g of NaOH and set to a temperature of 200°C had the gas pass through at a flow rate of 20 ml/min for two hours. Based on the measurement of the gas concentrations before and after the reaction, the ratio of difference in the concentrations at an inlet and an outlet was used as the decomposition factor (%). To achieve a decomposition factor of 90% without presence of a melt, all of the test samples required a temperature of 550°C or higher, while with presence of molten NaOH, the factor reached nearly 100% at 400°C in the samples A and B. The sample C showed somewhat inferior result. These relationships can be explained with three-dimensional disturbances in the nucleophilic reaction. 4 refs., 3 figs.

23832 (CONF-921275–, pp. 127-128) **Evaluation on combustibility of halogenized hydrocarbons using diffusion combustion process.** Matsui, H. (Research Institute of Industrial Safety, Tokyo (Japan)). 2 Dec 1992. 160p. (In Japanese). From 25. safety engineering study meeting; Kitakyushu (Japan); 2-3 Dec 1992. In *Proceedings of the 25th Safety Engineering Study Meeting.* Order Number DE93793904. Source: OSTI; NTIS (US Sales Only).

Because disposition of halogenized hydrocarbons presents problems from environmental issues and toxicity, their disposition using incineration requires full quantitative evaluation on their combustibility. This paper describes an attempt of applying as an index for the combustibility of halogenized hydrocarbons an oxygen index (OI = 100)×O2/(O2 + N2). Experiments were carried out on 24 kinds of halogenized hydrocarbons to obtain limiting oxygen concentrations in diffusion combustion (OI values), using a diffusion combustion testing device (according to the Ministry of Transport standard). A wick method was used when the samples are gaseous, and a cotton method when liquid, both methods provided reasonable results. Based on the resultant OI values, the combustibility was classified into three ranks, combustible (OI $\leq$ 30), fire-retardant (30$\leq$OI$\leq$60), and noncombustible (OI$\geq$60). Fire-retardant compound, for example, includes such a compound as CH3Br, and means those with no free diffusion combustion possible in air, but have an explosion limit in a gas mixed with air. 2 refs., 1 fig., 1 tab.

23833 (CONF-921276–, pp. 139-142) **Study on solar chemical heat pump system.: Experiment on dehydrogenation of 2-propanol and distillation of products.** Aoki, H. (Tokyo University of Agriculture and Technology, Tokyo (Japan)); Horigome, T.;

Doi, T.; Tanaka, T.; Takashima, T.; Fujii, T.; Kamoshida, J. 3 Dec 1992. 305p. (In Japanese). From 1992 Japan Solar Energy Society, Japan Wind Energy Association joint converence; Osaka (Japan); 3-4 Dec 1992. In *1992 JSES (Japan Solar Energy Society)/JWEA (Japan Wind Energy Association) Joint Conference.* Order Number DE93793955. Source: OSTI; NTIS (US Sales Only).

Chemical heat pump being taken notice of for the effective utilization of low temperature heat obtained from the solar energy, experiment was made on the decomposing reaction of 2-propanol and distillation/separation of its products by using a reaction plant having a distillation tower. The plant is composed of reaction vessel, distillation tower, agitator, reflux distibutor, condenser, etc. Treatment having been made through reduction by hydrogen before the reaction, fine metallic particles of nickel prepared through a gasborne evaporation method were used as a catalyst of endothermic reaction. Influence of fluctuation in heating quantity was small under the condition of 1/10 in reflux ratio, 100 centigrade in oil-heating vessel temperature and 540l/h in condenser-cooling water flow rate. The molar separation ratio of acetone of the distilled liquid at the top of tower could be changed by changing the reflux ratio under the condition of 110 centigrade in oil-heating vessel temperature and 530l/h in condenser-cooling water flow rate. Influence of reflux rate was not observed on the temperature in the lower portion of distillation tower and endothermic reaction. 3 refs., 5 figs.

23834 (DOE/BP–2017) **Cogeneration: A regulatory guide to leasing, permitting, and licensing in Idaho, Montana, Oregon, and Washington.** Deshaye, J. (Washington State Energy Office, Olympia, WA (United States)); Bloomquist, R.G. USDOE Bonneville Power Administration, Portland, OR (United States); Washington State Energy Office, Olympia, WA (United States); Oregon State Dept. of Energy, Salem, OR (United States). Dec 1992. 239p. Sponsored by USDOE, Washington, DC (United States). DOE Contract BI79-91BP16067. Order Number DE93012370. Source: OSTI; NTIS; GPO Dep.

This guidebook focuses on cogeneration development. It is one of a series of four guidebooks recently prepared to introduce the energy developer to the federal, state and local agencies that regulate energy facilities in Idaho, Montana, Oregon, and Washington (the Bonneville Power Administration Service Territory). It was prepared specifically to help cogeneration developers obtain the permits, licenses and approvals necessary to construct and operate a cogeneration facility. The regulations, agencies and policies described herein are subject to change. Changes are likely to occur whenever energy or a project becomes a political issue, a state legislature meets, a preexisting popular or valuable land use is thought threatened, elected and appointed officials change, and new directions are imposed on states and local governments by the federal government. Accordingly, cogeneration developers should verify and continuously monitor the status of laws and rules that might affect their plans. Developers are cautioned that the regulations described herein may only be a starting point on the road to obtaining all the necessary permits.

23835 (DOE/MC/11076–3338) **Evaluation of products recovered from scrap tires for use as asphalt modifiers.** McKay, J. Western Research Inst., Laramie, WY (United States). May 1992. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC21-86MC11076. Order Number DE93000275. Source: OSTI; NTIS; GPO Dep.

Western Research Institute performed rheological tests and water sensitivity tests on asphalt cements that had been modified with carbonous residues obtained from the pyrolysis of scrap tires and waste motor oil. These tests are part of an ongoing program at the University of Wyoming Chemical Engineering Department to evaluate, as asphalt additives, solid carbonous products recovered from the scrap tire and waste motor oil pyrolysis experiments conducted at the University. The tests showed that carbonous residues increased the viscosity and decreased the elasticity of AC-10 and AC-20 asphalts. The tests also indicatedthat asphalt cements modified with carbonous residues were less sensitive to water damage and age embrittlement than unmodified asphalt cements.

23836 (KCP–613-5193) **Establishing a comprehensive recycling process at KCD.** Beauchamp, B. Allied-Signal Aerospace Co., Kansas City, MO (United States). Kansas City Div. Apr 1993. 19p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00613. (CONF-930483–6: 9. waste minimization and pollution prevention conference, San Francisco, CA (United States), 13-15 Apr 1993). Order Number DE93012885. Source: OSTI; NTIS; GPO Dep.

An effort is being undertaken at the Kansas City Division to enhance its over-all recycling program by establishing a comprehensive recycling process. The objective of this recycling process is to optimize the use of our resources of people, equipment, time, and money as we search for ways to minimize the amount of waste generated and disposed of at our facility. The comprehensive recycling process which is being developed consists of a checklist which will help the user identify all the steps needed to take a recycling opportunity from initial concept to completed program in a manner which is effective and efficient. The purpose of this presentation is to address the efforts which have been, and are now being, made to achieve this objective.

23837 (NEI-DK–1150) **Analysis and optimization.** Energiministeriets Forskningsprogram. Erhvervslivets processer pg produkter. Christensen, S. (NU Energy A/S (Denmark)); Rovs Hansen, S.; Widell, K.E.; Broens Christensen, O.; Krogh Jensen, J. N og R Consult A/S, Alleroed (Denmark); NU Energy, Aalborg (Denmark). Dec 1992. [57p.] (In Danish). Contract ENs-1223/91-0007. Order Number DE93794692. Source: OSTI; NTIS.

EFP-91.

Danish industrial processes are responsible for 20% of the country's total energy consumption. It is claimed that systematic analysis and optimization of energy-consuming processes could substantially reduce this figure. It is possible to establish cogeneration plants for individual electric power and heat supply, this solution is also economically attractive. The overall aim was to initiate easy-to use computer simulations of industrial energy systems that can be utilized by consultants for analysis and optimization of individual industrial energy systems. This project describes the improvement of the simulation tool, the setting up of a module for the calculation of the economical consequences of the suggestions for a more efficient use of energy and a module for calculating the influence of sulfur oxides, nitrogen oxides, carbon dioxides and particles reduction on energy consumption. The final testing of the software is also described. (AB).

23838 (NEI-DK–1155) **Frigodan, Svendborg: Report on energy survey.** Jensen, N.E. Carl Bro Gruppen, Glostrup (Denmark). Mar 1993. 125p. (In Danish). Contract ENS-51191-92.0043. Order Number DE93794748. Source: OSTI; NTIS.

During the period July 1992 - February 1993 an energy survey was carried out at the Danish firm FRIGODAN in Svendborg. The firm produces frozen foods based on peas, carrots, leaks, rice and pasta. The energy-using equipment and the use of energy were examined on the basis of a registration of the former, of consumption measurements already made, a description of the pattern of operation given by an employee engineer and measurement of electric power consumption in relation to the cooling compressors already carried out by a local electric company. Energy consumption and production were analysed and a number of recommendations to improve energy efficiency by means of energy savings and improvements in the system involving economical aspects were given. Many possibilities for energy conservation were found, but not all were economically feasible. Total energy saving where the payback period could be under four years could be 1,606 MWh/yr. The cooling system could with advantage be rebuilt, but the repay period would be very long. (AB).

23839 (PNL–8600) **Workshop on coatings needs in the auto industry.** Courtright, E.L. Pacific Northwest Lab., Richland, WA (United States). May 1993. 46p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-9210343–Exc.Summ.: Workshop on coatings needs in the auto industry, Detroit, MI (United States), 27-28 Oct 1992). Order Number DE93013109. Source: OSTI; NTIS; GPO Dep.

New lightweight materials continue to be of great interest to the automotive industry. Compared to 20 years ago, the average vehicle weight has been reduced by almost a fourth, and fuel economy has nearly doubled. While continued improvements are both desirable and possible, materials choices are narrowing and the

manufacturing methods needed to produce advanced materials systems are much more costly. The incentives remain high, however; particularly in view of large payoffs associated with minimizing structural weight in electric and hybrid-type vehicles. One generic solution is to develop coatings that will enable the use of lower cost materials. A workshop on coatings needs in the auto industry was held in Detroit, Michigan on October 27 and 28, 1992 with the objective of identifying research needs where coatings could enhance the use of energy efficient lightweight materials for automotive applications. Four generic areas had previously been identified auto manufacturers and industry suppliers. These were: Wear Coatings, Hard Protective Coatings for Plastics, Solar Control Coatings, and Process Manufacturing Issues. The development of coatings and coating technologies for lightweight metals and metal matrix composites emerged as the number one research needs. This need underscores the interest in making better use of existing lightweight metals, e.g. magnesium, aluminum, and their alloys. Coatings to protect plastics and reinforced plastic composites were also identified as a major area of importance. Protection from automotive liquids and gases. Coatings that will improve mar resistance, resist UV degradation, or eliminate degradation due to moisture absorption are also needed. Accordingly, manufacturability issues associated with coating light metals, e.g. aluminum, magnesium, and metal matrix composites with wear and corrosion resistant materials, were identified as a high priority research need.

23840 (SAND–93-0347) **Sensor Based Process Control (SBPC) Laboratories Directed Research and Development (LDRD): Final report.** Wronosky, J.B. Sandia National Labs., Albuquerque, NM (United States). Mar 1993. 70p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. Order Number DE93013955. Source: OSTI; NTIS; GPO Dep.

This report describes the activities and results of an LDRD entitled Sensor Based Process Control. This research examined the needs of the plating industry for monitor and control capabilities with particular emphasis on water effluent from rinse baths. A personal computer-based monitor and control development system was used as a test bed.

23841 (SAND–93-0886) **Manufacturing technology: A Sandia technology bulletin.** Leonard, J.A.; Floyd, H.L.; Goetsch, B.; Doran, L. (eds.). Sandia National Labs., Albuquerque, NM (United States). Apr 1993. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. Order Number DE93013495. Source: OSTI; NTIS; GPO Dep.

This bulletin describes innovative manufacturing technologies being developed at Sandia National Laboratories. Topics in this issue include: new techniques to overcome barriers to large scale fabrication of vertical cavity surface-emitting lasers (VCSELs), variability reduction in plasma etching of microcircuits, using neural networks to evaluate effectiveness of flux-cleaning methods and alternative fluxes for printed circuit boards, ion implantation to increase the strength and wear resistance of aluminium, and a collaborative project to improve processing of thin-section welded assemblies. (GH)

23842 (UCRL-JC–110431) **Electroplating waste minimization at Lawrence Livermore National Laboratory.** Dini, J.W.; Steffani, C.P. Lawrence Livermore National Lab., CA (United States). Apr 1992. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-920851–93: Spectrum '92: nuclear and hazardous waste management international topical meeting, Boise, ID (United States), 23-27 Aug 1992). Order Number DE93012584. Source: OSTI; NTIS; INIS; GPO Dep.

This paper describes efforts on waste minimization in the electroplating facility at Lawrence Livermore National Laboratory (LLNL). Issues that are covered include: elimination of cadmium plating, copper cyanide plating, hexavalent chromium plating and vapor degreasing, segregation of cyanide solutions, changing rinsing practices, recycling of rinse water, changing cleaning of aluminum parts and rejuvenation of gold plating solutions. Discussion is also presented on other issues currently being worked and these include: combining electroplating and physical vapor deposition, elimination of all cyanide plating processes, and recycling of electroless nickel and spent acid solutions.

3206 Municipalities and Community Systems

Refer also to citation(s) 23271, 24115, 24143, 24580, 24974

23843 (CONF-930523–3) **Waste-to-energy: Decision making and the decisions made.** Schexnayder, S.M. (Tennessee Univ., Knoxville, TN (United States)); Wolfe, A.K. Oak Ridge National Lab., TN (United States). [1993]. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 18. National Association of Environmental Professionals (NAEP) annual conference on current and future priorities for environmental management; Raleigh, NC (United States); 24-26 May 1993. Order Number DE93011862. Source: OSTI; NTIS; GPO Dep.

During the early 1980s, it was projected that waste-to-energy (WTE) facilities would manage as much as half of all municipal solid waste by the turn of the century. However, during the latter part of the 1980s, the cancellation rate for WTE facilities grew to the point that the portion of the waste stream WTE will handle in the long-term future is less certain. This study, conducted as part of a larger study, identifies factors that influence municipalities, decisions regarding WTE. This study takes a broad perspective about decision-making within communities, emphasizing the context within which decisions were made and the decision-making process. It does not seek to judge the correctness of the decisions.

23844 (DOE/CE/26602–1) **A novel concept for heat transfer fluids used in district cooling systems: Progress report, September 25, 1990–December 31, 1990.** Cho, Y.I.; Choi, E.; Lorsch, H.G. Drexel Univ., Philadelphia, PA (United States). Dept. of Mechanical Engineering and Mechanics. 4 Jan 1991. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG01-90CE26602. Order Number DE93013298. Source: OSTI; NTIS; GPO Dep.

Low-temperature phase-change materials (PCMS) were mixed with water to enhance the performance of heat transfer fluid. Several PCMs were tested in a laboratory-scale test loop to check their suitability to district cooling applications. The phase-change temperatures and latent heats of fusion of tetradecane, pentadecane, and hexadecane paraffin waxes were measured using a differential scanning calorimeter. The heat of fusion of these materials is approximately 60% of that of ice. They exhibit no supercooling and are stable under repeated thermal cycling. For 10% and 25% PCM-water slurries, the heat transfer enhancement was found to be approximately 18 and 30 percent over the value of water, respectively. It was also found that, in the turbulent region, there is only a minor pumping penalty from the addition of up to 25% PCM to the water. It was demonstrated that pentadecane does not clog in a glass-tube chiller, and continuous pumping below its freezing, point (9.9°C):was successfully carried out in a bench-scale flow loop. Adding PCM to water increases the thermal capacity of the heat transfer fluid and therefore decreases the volume that needs to be pumped in a district cooling system. It also increases the heat transfer rate, resulting in smaller heat exchangers. Research is continuing on these fluids in order to determine their behavior in large-size loops and to arrive at optimum formulations.

23845 (DOE/CE/26602–2) **Thermal analysis of n-alkane phase change material mixtures: Progress report, January 1, 1991–March 31, 1991.** Chio, Y.I.; Choi, E.; Lorsch, H.G. Drexel Univ., Philadelphia, PA (United States). Dept. of Mechanical Engineering and Mechanics. 31 Mar 1991. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG01-90CE26602. Order Number DE93013299. Source: OSTI; NTIS; GPO Dep.

Tests were performed to characterize the thermal behavior of it number of n-alkanes to be used as phase change materials (PCMs) in district cooling applications. Hexadecane and tetradecane were mixed in different fractions, and their thermal behavior was experimentally evaluated. Test results for melting temperature and fusion energy for laboratory grade hexadecane and tetradecane showed good agreement with datain the literature. However, values for commercial grade hexadecane were found to be considerably lower. In the range of temperatures of interest for district

cooling, mixtures of tetradecane and hexadecane can be treated as homogeneous substances. However, their heats of fusion are slightly lower than those of the pure substances. Their melting temperatures are also lower by an amount that can be predicted.

23846 (DOE/CE/26602–3) **Effects of emulsifier on particle size of a phase change material in a mixture with water: Progress report, March 31, 1991–June 30, 1991.** Choi, E.; Cho, Y.I.; Lorsch, H.G. Drexel Univ., Philadelphia, PA (United States). Dept. of Mechanical Engineering and Mechanics. 30 Jun 1991. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG01-90CE26602. Order Number DE93013300. Source: OSTI; NTIS; GPO Dep.

The use of a phase-change material (PCM) in a district cooling system was studied in order to increase the heat transfer performance of the system. One of the major technical obstacles to its use is the clogging of the piping system. The present study attempts to minimize the clogging problem by using an emulsifier. Effects of the emulsifier on the mixture of water and hexadecane (a PCM) were studied. A small amount (60 to 2775 ppm) of emulsifier caused remarkable effects resulting in the production of fine PCM particles. As the amount of the emulsifier was increased in the 25% hexadecane mixture with water, the size of the solid particles of hexadecane became smaller. When the size of the hexadecane particles was small enough, they did not stick together or stick to the surface of the cold wall of a heat exchanger.

23847 (DOE/CE/26602–4) **Development of advanced low-temperature heat transfer fluids for district heating and cooling: Final report, September 25, 1990–September 24, 1991.** Drexel Univ., Philadelphia, PA (United States). 30 Sep 1991. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG01-90CE26602. Order Number DE93013301. Source: OSTI; NTIS; GPO Dep.

The feasibility of adding phase change materials (PCMs) and surfactants to the heat transfer fluids in district cooling systems was investigated. It increases the thermal capacity of the heat transfer fluid and therefore decreases the volume that needs to be pumped. It also increases the heat transfer rate, resulting in smaller heat exchangers. The thermal behavior of two potential PCMs, hexadecane and tetradecane paraffin wax, was experimentally evaluated. The heat of fusion of these materials is approximately 60% of that of ice. They exhibit no supercooling and are stable under repeated thermal cycling. While test results for laboratory grade materials showed good agreement with data in the literature, both melting point and heat of fusion for commercial grade hexadecane were found to be considerably lower than literaturevalues. PCM/water mixtures were tested in a laboratory-scale test loop to determine heat transfer and flow resistance properties. When using PCMs in district cooling systems, clogging of frozen PCM particles isone of the major problems to be overcome. In the present project it is proposed to minimize or prevent clogging by the addition of an emulsifier. Effects of the emulsifier on the mixture of water and hexadecane(a PCM) were studied. As the amount of the emulsifier was increased, the size of the solid PCM particles became smaller. When the size of the particles was small enough, they did not stick together or stick to the cold surface of a heat exchanger. The amount of emulsifier to produce this condition was determined.

23848 (EGG-EP–10715) **Air classification theory and design for municipal solid waste processing: Final report.** US-DOE Idaho Field Office, Idaho Falls, ID (United States); Duke Univ., Durham, NC (United States). Dept. of Civil and Environmental Engineering. Apr 1993. 39p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-76ID01570. Order Number DE93011851. Source: OSTI; NTIS; GPO Dep.

Research conducted at Duke University over the past 12 years has led to the development of a promising alternative method for processing municipal solid waste prior to energy production or resource recovery. Pulsed flow air classification is a laboratory-tested method which successfully separates the combustible from the noncombustible components of MSW. IN 1986, Duke subcontracted to EG&G Idaho to perform research in this area for the US Department of Energy. This document represent the final report of that effect, and places this research in the context of all air classification research conducted at Duke University. The goal of this final report is to document the history of pulsed flow air classifier theory and design, while emphasizing test results which confirm success with MSW processing. The three objectives are: Summarize the pulsed-flow air classification theory developed at Duke University; Document the equipment, procedures, test protocols, and results from research constructed at Duke University, with a focus on the combinations and classifier heights and feed rates which produce the best achievable separations, as well as a focus on the estimated cost of a complete classification system; Draw conclusions on the relative merits of selected air classifiers. The development of the theory and design of pulsed flow air classification is initially presented and experimental results are summarized. Pulsing and non-pulsing classifiers are discussed, and a complete system is designed and costed.

23849 (NEI-DK–1156) **Oxygen occurrence in total district-heating systems with a large number of plastic district heating pipes.** Energiministeriets Energiforskningsprogram. Fjernvarme og produktion af el og varme. Oestergaard, L. (Dansk Energi Management A/S, Viby J (Denmark)); Larsen, J.; Amby, L. Dansk Energi Management A/S, Viby (Denmark); Loegstoer Roer A/S (Denmark); Dansk Teknologisk Inst., Taastrup (Denmark). Mar 1993. 63p. (In Danish). Contract ENS-1323/91-0019. Order Number DE93794746. Source: OSTI; NTIS.

EFP-91.

The purpose was to measure the oxygen content of water in a district heating system including both plastic (64% of total grid, not including service pipes) and steel pipes taking seasonal and daily variations in temperature into account. The chemical water treatment was stopped before the measurements took place. The oxygen concentration did not exceed 10-20 μ g/l. Measurements were taken at the outflow from the power station, where the main pipe feeds the plastic pipes, at the consumer position furthest from the power station and where the main pipe feeds into steel pipes and returns to the power station. Whilst measurements of oxygen content during the winter period were stable, the results of measurements taken in July showed considerable variations in oxygen levels, from <10 μg/l to >100 μ g/l, as the steam cushion over the accumulating tank which prevents oxygen reaching the district heating water in the tank was not stable. Measurements were taken in the autumn on diameter 50 mm PEX pipes, steel pipes, plate radiators, unit and steel fittings. The oxygen level is a sign of balance in the system. The balance of oxygen is only an indirect sign of corrosion-related conditions, measurements showed that corrosion is also dependent on the flow of water and the temperature. It was shown that the oxygen content in the system resulting from plastic pipes is low. The level was about 0.25 μg/l, approximately one third of the lowest measured value. It is concluded that there should be no problems with oxygen diffusion through a PEX plastic pipe with an EVAL barrier. (AB).

23850 (NEI-DK–1161) **District heating master plan study and assessment. Debrecen: Final report.** Danish Energy Consultants, Glostrup (Denmark). Apr 1993. [120p.] Contract IMOe-480;Contract ENS-2124/92-0001. Order Number DE93794747. Source: OSTI; NTIS.

The aim was to prepare estimates of the future heat demand in Debrecen, Hungary, and to calculate the economic consequences of improvements of the district heating system. The energy consumption in the area is ca. 30% higher than in Denmark. It is estimated that two thirds of this difference can be saved over a 20 year period if energy prices and tariffs rise to world market levels, if consumers pay in accordance with consumption and if installations are improved. If cogeneration plants (115 MJ) are introduced, over a 20 year period the net present value of the total costs for investments, operation and maintenance will decrease from 116 to 80 million US dollars. If steam demand is included, the optimal size of the cogeneration unit would be ca. 140 MJ's. This would further decrease net present value if steam demand remained stable. Improvements of the district heating network would decrease total costs by a further 10 million US dollars. The overall assessment of the district heating system is that existing production units, pipes and substations are in a reasonable condition, and that there is scope for further energy saving. Environmental considerations are

discussed and detailed recommendations are given. Relevant market, financial, and technical aspects are dealt with and principles of design and hydraulic calculations are presented in addition to a feasibility analysis. The latter gives an indication of which measures concerning the distribution system and heat consumption are economically viable and of the advantages of installing cogeneration plants as compared to retaining the use of existing boilers producing heat only. (AB).

23851 (NYSERDA–93-2) **Binghamton/Johnson City Joint Sewage Treatment Plant cogeneration project: Final report.** New York State Energy Research and Development Authority, Albany, NY (United States); SCS Engineers, Inc., West Nyack, NY (United States). Feb 1993. 167p. Sponsored by New York State Energy Research and Development Authority, Albany, NY (United States). Source: OSTI; New York State Energy Research and Development Authority, Two Rockefeller Plaza, Albany, NY 12223.

This report describes a cogeneration system implemented at a wastewater treatment plant in Vestal, New York. The system consists of a 200 kW spark-ignited reciprocating engine driving an induction type electric generator. Also included in the system are two heat exchangers used to recover thermal energy from the engine. Thermal energy recovered is transferred to a system that heats wastewater sludge prior to the sludge being admitted to anaerobic digestion units. The digestion units produce the fuel used in the engine, a medium Btu fuel consisting primarily of methane and carbon dioxide, with a heating content of approximately 650 Btu per standard cubic foot. Use of the digester gas in the engine reduces the amount of excess digester gas burned in a flare. Electricity generated is used in the plant to reduce purchases from the electric utility. The report describes the unit operations at the plant and their energy uses, opportunities for saving energy, the cogeneration system equipment installed, implementation issues including capital costs and events during the 1986–1987 construction, results of operation during a 12 month period of monitoring, and an economic analysis of the project.

23852 (ORNL/CON–356) **Evaluation of the computerized utilities and energy monitoring and control system installed at the US Army, Europe, 222D Base Support Battalion, Baumholder, Germany.** Gettings, M.B.; Purucker, S.L. Oak Ridge National Lab., TN (United States). Nov 1992. 54p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93012427. Source: OSTI; NTIS; GPO Dep.

ORNL the utilities and energy monitoring and control systems (UEMCSs) installed at the 222D Base Support Battalion (BSB) at Baumholder, Germany. This evaluation relies on examination of existing data and information to determine the effectiveness of the UEMCSs. The Baumholder BSB consists of numerous installations located as far as 63 miles from the principal installation at Baumholder. Only five facilities within these installations currently have support from four essentially separate UEMCSs A Messner/Miles and two Honeywell systems, which combined have 4600 points serving 200 buildings, perform traditional UEMCS functions associated with district heating, while a Landis & Gyr UEMCS is used exclusively for electrical demand limiting and exterior lighting control. Total energy consumption at the community has steadily decreased since 1986 because of the implementation of UEMCS and the conversion to district heat. However, lack of annual energy consumption data by individual installation makes direct association of energy reductions to the implementation of specific UEMCSs difficult. Engineering estimates predict approximately a 6% annual energy savings associated with the UEMCSs of DM 1.9 million. However, less than 40% of the total community building area is connected. Opportunities for additional savings are available through (1) expanded use of demand limiting, (2) increased memory for the older Honeywell system to allow extending its application at the Smith Barracks facility and facilities nearby, (3) use of available UEMCS equipment to shut off the domestic hot water circulation pumps at night, (4) extension of UEMCS control at the Neubruecke Hospital complex, and (5) installation and utilization of heating hot water and potable hot water leak detection equipment. A moderate effort to track energy consumption by facility should be undertaken and data transmission lines associated with the UEMCS inspected and repaired.

23853 (ORNL/FTR–4403) **Evaluation of the energy-conservation effectiveness and utilization of the UEMCS installed at the 409th BSB in Germany: Foreign trip report, September 4–19, 1992.** Ruppel, F.R.; Broders, M.A. Oak Ridge National Lab., TN (United States). 9 Oct 1992. 8p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93011092. Source: OSTI; NTIS (US Sales Only); GPO Dep.

An on-site evaluation of the energy-conservation effectiveness and utilization of the UEMCS installed at the 409th BSB in Germany was performed. On-site activities consisted of interviewing key UEMCS and energy-management personnel, touring facilities controlled by the UEMCS and other facilities with potential energy-conservation opportunities, and gathering historical thermal and electrical energy usage data for later analysis. Preliminary findings and recommendations were made on site.

3209 Education and Public Relations

Refer also to citation(s) 23815

33 ADVANCED PROPULSION SYSTEMS

Refer also to citation(s) 23839, 24135

23854 (UCRL-JC–110921) **Whistler wave driven plasma thruster.** Hooper, E.B.; Stallard, B.W.; Makowski, M.A. Lawrence Livermore National Lab., CA (United States). 5 Oct 1992. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-930103–39: 10. symposium on space nuclear power and propulsion, Albuquerque, NM (United States), 10-14 Jan 1993). Order Number DE93014122. Source: OSTI; NTIS; GPO Dep.

High density plasma can be generated by electron cyclotron resonance heating (ECRH) using whistler waves at densities for which the plasma frequency is much higher than the cyclotron frequency. This will result in a thruster operating at specific impulses of 10^3–10^4 s and much higher power and thrust densities than usual for ECRH devices. As the plasma generation is by electromagnetic waves, there are no electrodes, and wall material problems are greatly eased, permitting reliable, long lifetime operation. The authors report on the modeling of such a thruster, including plasma flow as well as losses to an end wall and ionization. A helical antenna to couple the waves into the plasma column is analyzed, including effects of the anisotropic plasma dielectric constant. An initial experiment to test the concept is planned.

3301 Internal Combustion Engines

Refer also to citation(s) 22697, 22698, 22755, 23873, 23876, 23877, 23881, 23882, 23884, 23885, 24267

23855 (CONF-9207203–, pp. 247-250) **Emission characteristic in pre-vaporizing pre-mixing combustion with multi-fuels.** Yoshida, Y. (Japan Automobile Research Institute, Tsukuba (Japan)); Hayashi, S. 22 Jul 1992. 320p. (In Japanese). From 1. meeting of The Japan Institute of Energy and the 70th Foundation anniversary meeting; Tokyo (Japan); 22-24 Jul 1992. In *Proceedings of the 1st Meeting of the Japan Institute of Energy and the 70th Foundation Anniversary Meeting.* Order Number DE93793523. Source: OSTI; NTIS (US Sales Only).

While a gas turbine is expected as a future automotive engine for its high efficiency and multi-fuel applicability, achieving a thermal efficiency of 40% requires as high temperature as 1000°C at a combustor inlet. To make this temperature available, it is necessary to establish a new low-NOx combustion technology including pre-vaporing pre-mixing combustion. This paper describes investigations on flame stability and exhaust properties of light oil, cracked light oil, and methanol when the inlet temperature (T_a) was raised to 700°C using an experimental pre-vaporing pre-mixing combustor. Discussions were also given on possibility of reducing

NOx in each fuel. The flame stability was discovered in the order of wider combustion range as light oil > cracked light oil > methanol. The average temperature of the combustion gases under a test condition with T_a of 700°C was 1150°C for the light oil, 1100°C for the cracked light oil, and 1250°C for methanol. The exhaust NOx discharge coefficient was, when that for the light oil is set to 1, three for the cracked light oil, and 1/10 for methanol. 3 refs., 4 figs., 2 tabs.

23856 (CONF-9207203–, pp. 261-264) **Recent trend of automotive catalysts.** Sofukawa, H. (Toyota Central Research and Development Laboratories, Inc., Aichi (Japan)). 22 Jul 1992. 320p. (In Japanese). From 1. meeting of The Japan Institute of Energy and the 70th Foundation anniversary meeting; Tokyo (Japan); 22-24 Jul 1992. In *Proceedings of the 1st Meeting of the Japan Institute of Energy and the 70th Foundation Anniversary Meeting.* Order Number DE93793523. Source: OSTI; NTIS (US Sales Only).

With the growing public concern over environmental problems and the improvement of automobiles in their performance, the role to be played by automative catalyst is being greatly enhanced. This paper explains the present status of ternary automative catalyst and problems to be solved in this matter. At present, monolith type ternary catalysts are predominently used and recently metal monolith carriers excellent in loading capacity and pressure loss are partly adopted. In usual ternary catalysts, base metal oxides such as Ce, La and Zr are used in addition to noble metals such as Pt, Pd and Rh. Rh is an indispensable element for reducing NO, and Pt is used for supplementing the oxidation activity of Rh because of its excellence in the low-temperature oxidation of CO and HC. CeO2 is loaded on all kinds of ternary catalysts so as to smooth the catalytic reaction in varying conditions of A/F ratio on account of its adsorptive-desorptive power for oxygen. Many problems relating to catalysts remain still unsolved and include enhancement of heat-resistance, improvement in low-temperature activity, lowering of the quantity of noble-metal carrier, removal of particulates and NOx, etc. 10 refs., 4 figs.

23857 (CONF-9207203–, pp. 269-272) **Reduction of NOx by copper catalyst loaded on brown coal.** Yamashita, H. (Tohoku University, Sendai (Japan). Institute for Chemical Reaction Science); Yamada, H.; Kyotani, T.; Tomita, A.; Radovic, L. 22 Jul 1992. 320p. (In Japanese). From 1. meeting of The Japan Institute of Energy and the 70th Foundation anniversary meeting; Tokyo (Japan); 22-24 Jul 1992. In *Proceedings of the 1st Meeting of the Japan Institute of Energy and the 70th Foundation Anniversary Meeting.* Order Number DE93793523. Source: OSTI; NTIS (US Sales Only).

Development of a catalyst is requested which disintegrates NOx contained in the exhaust gas of diesel engines. The present paper describes the results of an experiment carried out for investigating the preparative conditions of Cu/brown coal char and its reaction mechanism, based on the results which were obtained before the time of a previous report and show that carbon loaded with metallic catalyst in the presence of oxygen is useful as reductant of NOx and so forth. Brown coal was impregnated and loaded with an aqueous solution of copper acetate and then converted to char in nitrogen atmosphere at 650°C. The standard amount of loaded substance was 2wt.% in terms of the amount of brown coal. A mixture of 1000ppm NO, 5% O2, and balance He was subjected to a reaction experiment around the conditions of 100ml/min, and 300°C. As a result, it was found that while carbon consumption decreases as the loaded amount of copper in the catalyst is decreased, the conversion rate of NOx does not decrease so much in the range of 2-0.5%; high charring temperature decreases the conversion activity of NOx and, at the same time, it gives possibility of elongating the life of carbon and so forth. 2 refs., 3 figs.

23858 (CONF-9207203–, pp. 273-276) **NOx reduction in diesel exhaust gas by using hydrocarbons.** Muramatsu, G. (Riken Corporation, Tokyo (Japan)); Abe, A.; Yoshida, K. 22 Jul 1992. 320p. (In Japanese). From 1. meeting of The Japan Institute of Energy and the 70th Foundation anniversary meeting; Tokyo (Japan); 22-24 Jul 1992. In *Proceedings of the 1st Meeting of the Japan Institute of Energy and the 70th Foundation Anniversary Meeting.* Order Number DE93793523. Source: OSTI; NTIS (US Sales Only).

It is an important problem to reduce the amounts of NOx and particulates exhausted from diesel engines. The present report clarifies NOx reduction characteristics of various kinds of hydrocarbons loaded on various catalysts and their catalytic reactions, and describes the results of an investigation on the practical use of a system using light oil and a Cu-based-group/Al2O3 catalyst. NOx reduction characteristics of Al2O3 catalyst loading various kinds of metal for a mixture of a hydrocarbon, or C3H6, NO, and O2 were examined and the priority of Cu-based catalyst was found. A comparisonal experiment using hydrocarbons ranging from C2 to C16 showed that ca. 30% reduction of NOx is obtained in the vicinity of 400°C by light oil mainly composed of C16 H34, suggesting practicability of such light oil together with its resistance against water vapor and SO2. Since the Cu-based-group/Al2O3 catalyst is characterized in its capability of simultaneous removal of NOx and particulates, its use together with light oil is expected to be effective, but such problem as enlargement of effective temperature region also remains. 8 refs., 4 figs.

23859 (CONF-9211101–9) **Low-expansion ceramics initiative.** Stinton, D.P. (Oak Ridge National Lab., TN (United States)); Richerson, D.W. Oak Ridge National Lab., TN (United States). [1992]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From Annual automotive development technology contractors' coordination meeting; Dearborn, MI (United States); 2-5 Nov 1992. Order Number DE93011860. Source: OSTI; NTIS; GPO Dep.

The US Department of Energy and the Ceramic Technology Project support technology on low-thermal-expansion ceramics for application in advanced diesel and turbine engines. New activities are being initiated to accelerate the development of these materials. The strength of this program includes the integration of efforts of engine companies, ceramic manufacturers, and universities. This paper briefly describes the application of the low-expansion sodium-zirconium-phosphate (NZP) class of materials in engines and summarizes a 2-year program plan for this area.

23860 (ORNL/FTR–4301) **Travel to Germany to attend the 37th American Society for Mechanical Engineers gas turbine and aeroengine congress and exposition: Foreign trip report, May 29, 1992–June 10, 1992.** Tennery, V.J. Oak Ridge National Lab., TN (United States). 25 Jun 1992. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93011058. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The traveler attended technical presential presentations on recent material developments relevant to gas turbines and to assess new alloys for gas turbines. Work on monolithic structural ceramics in gas turbines is at low ebb in Europe, with the only major efforts being in USA and, especially, Japan. Mechanical properties of these materials have undergone major improvement, particularly in the Si nitride type. Ti aluminides show promise for several applications, including compressor blades in high-performance aircraft turbines. Lack of reproducible mechanical properties and low-cost machining are hindering use of monolithic ceramics in aeroengines; continuous fiber- reinforced ceramic matrix composites have even greater problems. Fraunhofer IPT has technology for machining ceramics accurately. (DLC)

23861 (UCRL-JC–110069-Rev.1) **The intensity of knock in an internal combustion engine: An experimental and modeling study: Revision 1.** Cowart, J.S.; Haghooie, M.; Newman, C.E.; Davis, G.C.; Pitz, W.J.; Westbrook, C.K. Lawrence Livermore National Lab., CA (United States). Sep 1992. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9210140–2-Rev.1: International fuels and lubricants meeting and exposition, San Francisco, CA (United States), 19-22 Oct 1992). Order Number DE93013089. Source: OSTI; NTIS; GPO Dep.

Experimental data have been obtained that characterize knock occurrence times and knock intensities in a spark ignition engine operating on indolene and 91 primary reference fuel, as spark timing and inlet temperature were varied. Individual, in-cylinder pressure histories measured under knocking conditions were conditioned and averaged to obtain representative pressure traces.

These averaged pressure histories were used as input to a reduced and detailed chemical kinetic model. The time derivative of CO concentration and temperature were correlated with the measured knock intensity and percent cycles knocking. The goal was to evaluate the potential of using homogeneous, chemical kinetic models as predictive tools for knock intensity.

3302 External Combustion Engines

23862 (NAL-TR–1149) **Studies on scramjet nozzles. 1.: Performance of two dimensional nozzles.** Miyajima, H. (National Aerospace Laboratory, Tokyo (Japan)); Mitani, T.; Sato, S.; Ueda, S.; Tani, K.; Hiraiwa, T.; Ito, K.; Kusaka, K.; Izumikawa, M.; Kisara, K.; Kumagai, T.; Saito, T.; Sakuranaka, N.; Takahashi, M.; Tanaka, A.; Yasu, S.; Higashino, K.;.National Aerospace Lab., Chofu, Tokyo (Japan). Apr 1992. 49p. (In Japanese). Order Number DE93793617. Source: OSTI; NTIS; Available from National Aerospace Laboratory, 44-1, Shindaiji Higashicho 7-chome, Chofu-City, Tokyo, Japan.

Investigations were made on performance of scram jet nozzles under a Mach 8 flight condition, using high temperature gas made from burning monomethyl-hydrazine and nitrogen tetraoxide. The test items included nozzle thrust, nozzle wall pressure distribution, pitot pressure, and static pressure distribution. A nozzle visualization experiment was also carried out. The analytic method used was the one JANNAF has applied for rocket nozzles. The following findings were obtained: This nozzle has a small thrust increment, but it corresponds to 1100 seconds as converted to a flow rate; nozzle flow fields were calculated using non-viscosity two-dimensional codes to verify the accuracy by comparing the results with experimental values; energy efficiency, non-equilibrium loss, and two-dimensional loss were identified from these calculations; core flow performance using these codes can be predicted with an accuracy of 4% or higher; the boundary layer in the case of using this combustion gas suggested a possibility of a laminar flow; and effect of radical activity loss reaction on the performance was investigated, by which the reaction mechanisms of nozzle flows were clarified. 73 refs., 40 figs., 5 tabs.

23863 (NAL-TR–1155) **Durability of a carbon segmented circumferential seal for a liquid oxygen turbopump.** Kikuchi, M. (National Aerospace Laboratory, Tokyo (Japan)); Oike, M.; Watanabe, Y.; Nosaka, M. National Aerospace Lab., Chofu, Tokyo (Japan). May 1992. 15p. (In Japanese). Order Number DE93793619. Source: OSTI; NTIS; Available from National Aerospace Laboratory, 44-1, Shindaiji Higashicho 7-chome, Chofu-City, Tokyo, Japan.

With an objective to improve durability of a helium purge seal used for the liquid oxygen turbopump in the LE-7 rocket engine, discussions were given on friction characteristics of a carbon segmented seal with Rayleigh steps. Five combinations of sealing materials were used on the static and the rotating sides. A simulated turbopump was used for the test. An increase in the purge pressure and a decrease in the runner rotation speed raise the pressing force acting on the carbon segments and accelerate wear in the carbon. Carbon materials with superior mechanical properties do not necessarily exhibit good friction characteristics. An MoS2 film existing between the seal faces works effectively to reduce wear in the carbon segments. A combination of a runner of plasma sprayed Cr2O3 film with with a seal of the MoS2 sprayed film showed excellent durability under a wide range of test conditions because of good friction compatibility in both materials. It was verified that good correlation existed between a pin-rotating disk type friction testing machine and a seal testing machine. 10 refs., 17 figs., 7 tabs.

23864 (NAL-TR–1174T) **Numerical calculation of scramjet inlet flow.** Ishiguro, T. (National Aerospace Laboratory, Tokyo (Japan)); Ogawa, S.; Wada, Y. National Aerospace Lab., Chofu, Tokyo (Japan). Jul 1992. 29p. Order Number DE93793626. Source: OSTI; NTIS; Available from National Aerospace Laboratory, 44-1, Shindaiji Higashicho 7-chome, Chofu-City, Tokyo, Japan.

The numerical calculation procedure was proposed to analyze scramjet inlet flowfields. In order to accurately treat boundary conditions such as wall and edge, all boundaries were mapped onto certain parts of the faces of three rectangular parallelepipeds, and a computational space was made by connecting them. The 3-D full Navier-Stokes equations were solved by applying a TVD scheme to uniform mesh points of the space. The influence of various parameters on inlet performance (mass capture ratio, total pressure recovery ratio, possibility of starting) was discussed assuming freestream Mach numbers (M) of 2-10, sweep angles of a side plate leading edge of 0-60°, and entrance/throat contraction ratios (R) of 3-10 as parameters. As a result, the calculation results well agreed with the experimental ones at M = 4 in starting, where iterated reflective oblique shock waves made by wedges of side panels decelerated and compressed air. Unstarting phenomenon was observed in the case of either low M or high R. 22 refs., 40 figs.

23865 (UCRL-CR–109570) **Test results of a pumped monopropellant propulsion system.** Maybee, J.C. (Rocket Research Co., Redmond, WA (United States)); Brewster, G.T.; Swink, D.G. Lawrence Livermore National Lab., CA (United States); Rocket Research Co., Redmond, WA (United States). 31 Jan 1992. 26p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE93013042. Source: OSTI; NTIS; GPO Dep.

A breadboard demonstration of a pumped monopropellant propulsion system was completed during 1991. The propulsion system is the central part of the miniaturized maneuvering vehicle design presented and discussed in previous papers. Progress during 1991 included testing at the subsystem level to demonstrate the bootstrap startup capability of the design, and testing at the system level of a bolt-down breadboard unit which consisted of the warm gas pumps, gas generator, propellant tanks, thrust control valve assembly, regulator, bridge structure, attitude control thrusters, and two 56-lbf hydrazine thrusters. These two test series demonstrated the viability of the concept and results are presented and discussed from each test. The test results and post-test correlations with a mathematical model have resulted in refinements to component specifications.

3303 Electric-Powered Systems

Refer also to citation(s) 23250, 23252, 23253, 23694, 23697

23866 (CONF-921276–, pp. 111-114) **Development of solar-assisted super energy efficient vehicle.** Saito, T. (Tohoku University, Sendai (Japan). Faculty of Engineering); Koshikawa, H.; Kiyokuni, T. 3 Dec 1992. 305p. (In Japanese). From 1992 Japan Solar Energy Society, Japan Wind Energy Association joint conference; Osaka (Japan); 3-4 Dec 1992. In *1992 JSES (Japan Solar Energy Society)/JWEA (Japan Wind Energy Association) Joint Conference.* Order Number DE93793955. Source: OSTI; NTIS (US Sales Only).

The usefulness and feasility of solar bike (bicycle) were discussed by experimentally building up its prototype and measuring its energy consumption, regenerative power and traveling performance. Photovoltaic (PV) cells, motor, controller and batteries were mounted on the bicuycle as a vehicle, which was proposed by a given name of 'Super Solar Bike (SSB)'. Power which is diurnally generated by the PV cells fitted on the front and rear wheels during the travelling, and the other ones fitted with protrusion in addition to the above ones during the parking is reserved in Ni-Zn batteries for being used as power for the driving use motor. At the time of deceleration, kinematic energy of vehicle body is converted into electric energy and then recovered. It was known that the power which was obtained from the PV cells fitted on the wheels during the traveling was about 16W and that the energy daily recoverable was about 230Wh during the parking. As a result of simulation, the prototype vehicle was 0.57 in transmission efficiency. The distance travelable by one time of charging was 123km on the even road. 4 refs., 6 figs., 3 tabs.

23867 (DOE/CE/50337–T1) **Technology assessments of advanced energy storage systems for electric and hybrid vehicles.** Abacus Technology Corp., Chevy Chase, MD (United States). 30 Apr 1993. 117p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC01-91CE50337. Order Number DE93014395. Source: OSTI; NTIS; GPO Dep.

Flywheels, hydropneumatic accumulators (in vehicles with a hydrostatic powertrain), and superconducting magnets were assessed as candidate technologies for recovering braking energy and averaging power demands in electric and hybrid vehicles. The technologies were also assessed for their suitability for fulfilling the entire energy storage requirement in vehicles. The scope of the technology assessments included the current state-of-the-art and developments anticipated within the next few years in the US and abroad. Key individuals and companies currently working on each technology contributed technical information to the study. Some of these individuals and companies are nearing the pre-production prototype stage with systems suitable for automobiles. Several have constructed systems using similar technology for other applications, including satellites and industrial equipment.

23868 (DOE/NV/10649–T1) **Research development and demonstration of a fuel cell/battery powered bus system: Annual report, January 1, 1992–December 31, 1992.** Romano, S.; Wimmer, R. Georgetown Univ., Washington, DC (United States). 4 Feb 1993. 218p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-87NV10649. Order Number DE93013778. Source: OSTI; NTIS; INIS; GPO Dep.

During 1992, the design of the three test bed buses evolved. Georgetown participated in all the working meetings and the preliminary design review of the Test Bed Bus (TBB). Throughout the Year, Georgetown provided input on system design and integration issues, transit industry requirements, and bus performance. GU also attended technical seminars, presenting papers at two. The computer simulation "HYBRID", developed by Georgetown, was used to assess performance of different bus designs and system control algorithms. GU also modified the simulation to be more flexible and allow easier evaluation Of designs. Georgetown had Exhibitgroup design and construct, to our specifications, a fuel cell bus display with a 1/10 scale model of the TBB for use at trade shows and exhibits. Energy Partners Of West Palm Beach, Florida completed their subcontract for the engineering design study of a hydrogen fueled, fuel-cell-powered multi-passenger vehicle. Georgetown performed a study to determine the size of the US bus fleet and expected new bus deliveries over the next 10 years. Trojan Battery Company of Santa Fe Springs, California conducted a study to determine the specific design characteristics required of a leadacid battery to meet the special requirements posed by hybrid vehicle operation. Finally, GU assisted the prime contractor with the design of the system controller and its control algorithms.

23869 (EGG-EP–9831) **Study of long term options for electric vehicle air conditioning.** Dieckmann, J. (Little (Arthur D.), Inc., Cambridge, MA (United States)); Mallory, D. EG and G Idaho, Inc., Idaho Falls, ID (United States); Little (Arthur D.), Inc., Cambridge, MA (United States). Jul 1991. 151p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-76ID01570. Order Number DE93013588. Source: OSTI; NTIS; GPO Dep.

There are strong incentives in terms of national energy and environmental policy to encourage the commercialization of electrically powered vehicles in the U.S. Among these incentives are reduced petroleum consumption, improved electric generation capacity utilization, reduced IC engine emissions, and, depending on the primary fuel used for electric power generation, reduced emissions of carbon dioxide. A basic requirement for successfully commercializing any motor vehicle in the US is provision of adequate passenger comfort heating and air conditioning (cooling). Although air conditioning is generally sold as optional equipment, in excess of 80% of the automobiles and small trucks sold in the US have air conditioning systems. In current, pre-commercial electric vehicles, comfort heating is provided by a liquid fuel fired heater that heats water which is circulated through the standard heater core in the conventional interior air handling unit. Air conditioning is provided by electric motor driven compressors, installed in a system having, perhaps, an "upsized" condenser and a standard evaporator (front and rear evaporators in some instances) installed in the conventional interior air handler. Although this approach is adequate in the near term for initial commercialization efforts, a number of shortcomings of this arrangement, as well as longer range concerns need to be addressed. In this project, the long term alternatives for cooling and heating electric vehicles effectively, efficiently (with minimum range penalties), and without adverse environmental impacts have been examined. Identification of options that can provide both heating and cooling is important, in view of the disadvantages of carrying separate heating and cooling systems in the vehicle.

3306 Vehicle Design Factors

23870 (CONF-921275–, pp. 1-2) **Evaluation on reliability of air-bag ignition device.** Saito, Y. (Yokohama National University, Yokohama (Japan)); Miyake, A.; Ogawa, T.; Kojima, Y.; Shimosada, H. 2 Dec 1992. 160p. (In Japanese). From 25. safety engineering study meeting; Kitakyushu (Japan); 2-3 Dec 1992. In *Proceedings of the 25th Safety Engineering Study Meeting.* Order Number DE93793904. Source: OSTI; NTIS (US Sales Only).

A non-destructive test was carried out on an ignition device for an automotive air-bag system to evaluate its reliability. A thermal transient testing method was developed that gives constant micro current pulses to the ignition device to observe voltage change in the bridge circuit on an oscilloscope. The voltage change indicates temperature rise at the bridge, where the energy given to the bridge as a result of the energization is the sum of heat dissipation to the igniting powder and the temperature rise in the bridge. The collective coefficient for heat transfer between the igniting powder and the bridge is an important element to determine performance of the ignition device. The present test method was applied to ignition devices with structural defects to compare the result with the data for normal products. The defective products had the voltage change distribution that largely differ from that for the normal products, while probability density functions were derived for the voltage change amount, respectively. The functions were used to set the voltage change amount that the relative frequency of defect occurrence becomes 0.0001% or lower as the determination criterion. The results of tests using this method were compared with those from actual ignition tests, and the reasonability of the determination criterion was verified. 3 figs., 1 tab.

23871 (CONF-921275–, pp. 159-160) **Measurement of flash point and ignition point of brake fluids.** Hara, M. (Kanagawa Prefectural Government, Yokohama (Japan)); Ikeda, Y.; Kawakami, A. 2 Dec 1992. 160p. (In Japanese). From 25. safety engineering study meeting; Kitakyushu (Japan); 2-3 Dec 1992. In *Proceedings of the 25th Safety Engineering Study Meeting.* Order Number DE93793904. Source: OSTI; NTIS (US Sales Only).

Brake fluids were added to distilled water to investigate relation between the boiling points, flash points, and ignition points to discuss possibilities of automobile fire occurrence. The boiling points were 250°C or higher at a water content of 0%, except for one brand, which decreased with the higher the water content, while the flash points rose with increasing water content. On the other hand, it was found that the experimental expression to infer a flash point from a boiling point cannot be applied to brake fluids. The ignition points rose with increasing water content. As a result of measuring temperatures in an exhaust manifold and other parts of a passenger car driven on an upslope, the temperature in the exhaust manifold reached 315°C and in the exhaust pipe 262°C during acceleration for passing. It was also reported that as a result of measuring temperatures in a braking system in a car driven on a downslope, the temperatures were 230°C in the front wheels, 900°C in the disk-brake pads, and 650°C in the rotors. This would mean that if brake fluid leaks and deposits on high-temperature parts such as an exhaust manifold, the brake fluid may ignite. 4 refs., 4 figs.

3307 Emission Control

Refer also to citation(s) 23856, 23857, 23858, 24627

23872 (CONF-9207203–, pp. 209-214) **Deep desulfurization from light oil.: Its recent trend.** Kabe, T. (Tokyo University of Agriculture and Technology, Tokyo (Japan). Faculty of Technology). 22 Jul 1992. 320p. (In Japanese). From 1. meeting of The Japan Institute of Energy and the 70th Foundation anniversary meeting; Tokyo (Japan); 22-24 Jul 1992. In *Proceedings of the 1st Meeting*

of the Japan Institute of Energy and the 70th Foundation Anniversary Meeting. Order Number DE93793523. Source: OSTI; NTIS (US Sales Only).

With air pollution caused from diesel engine exhausts having become serious, development of highly active catalysts is wanted strongly that can operate under deep desulfurizing conditions in order to achieve the governmental target of S content at 0.05% by weight. However, there are many unclear points remaining in the reaction mechanisms under deep desulfurizing conditions. This paper describes processes to reduce sulfur compounds produced along with deep desulfurization from light oil, the reaction mechanisms, and guidelines for catalyst development. From results of detailed analyses of material oils and those desulfurized at a temperature from 350°C to 390°C it was found that alkyldibenzothiophene is difficult to remove sulfur, and especially 4-methyldibenzothiophene remain even at 390°C because of the substitutional groups preventing the compound from getting closer to the catalyst surface. Effects of these substitutional groups and solvents were investigated kinetically. Several important guidelines were presented including isomerization of methyldibenzothiophenes as a guideline for developing deep desulfurization catalysts. 5 refs., 11 figs.

23873 (CONF-9207203–, pp. 241-244) **Combustion and smoke formation characteristics and their mechanisms in D.I. diesel engines.** Fadzili, a. (Hokkaido University, Sapporo (Japan). Faculty of Engineering); Chikahisa, T; Murayama, T.; Tosaka, S.; Fujiwara, Y. 22 Jul 1992. 320p. (In Japanese). From 1. meeting of The Japan Institute of Energy and the 70th Foundation anniversary meeting; Tokyo (Japan); 22-24 Jul 1992. In *Proceedings of the 1st Meeting of the Japan Institute of Energy and the 70th Foundation Anniversary Meeting.* Order Number DE93793523. Source: OSTI; NTIS (US Sales Only).

This paper discusses combustion and smoke formation characteristics in diesel engines as clarified in the previous report which investigated the optimal conditions for fuel injection systems and swirl. The water cooled single cylinder direct fuel injection four-cycle diesel engines used for the experiment included a flat type combustion engine with a bore of 85 mm and flat pins, and a basin type combustion engine with a bore of 125 mm and toroidal type cavity. Combustion trends were compared varying the swirl ratio, the number of injection holes, and total injection hole area, from which the following findings were obtained: with the flat type combustion chamber, the change trends in heat generation and exhaust smoke correspond well with each other; these changes that result from varying number of nozzle injection holes and the swirl can be predicted from a theory based on introducing air in a Jet flow; and an engine with a cavity tends to produce a large amount of smoke at the top clearance, often generating much smoke even though the heat generation efficiency is high, where a qualitative prediction is also possible. 3 refs., 2 figs.

23874 (CONF-9207203–, pp. 245-246) **Non-combustive gasification of KOH-treated fuel soot.** Saito, Y. (Ibaraki College of Technonology, Ibaraki (Japan)). 22 Jul 1992. 320p. (In Japanese). From 1. meeting of The Japan Institute of Energy and the 70th Foundation anniversary meeting; Tokyo (Japan); 22-24 Jul 1992. In *Proceedings of the 1st Meeting of the Japan Institute of Energy and the 70th Foundation Anniversary Meeting.* Order Number DE93793523. Source: OSTI; NTIS (US Sales Only).

Removal of carbon particles (soot) from automobile exhaust using a trap renders a problem of post-treatment thereof. With an objective of converting the soot into C1 compounds other than CO2 using non-combustive gasification, this paper describes an investigation on effect of alkaline treatment of carbon. Soot was poured with alkaline aqueous solution added with a surfactant, kneaded into paste, added with the remaining aqueous solution, evaporated, dried, and washed with water, and then subjected to a gasification reaction. The material was charged into a U-letter shaped reaction tube, deaerated, and then gasified through water and accompanying gases (CO2 and He). It was found that CO and H2 generating velocity becomes several ten times faster as a result of adding KOH in the water gas reaction of either H2O/He system or H2O/CO2 system. The DTA-TG measurements revealed that KOH accelerates combustion of soot in air and steam adsorption. Methanizing decomposed gases is possible, but loss of catalytic activity cannot be neglected. 1 fig., 1 tab.

23875 (CONF-9207203–, pp. 251-254) **Carbon-dioxide free gasoline fueled car.** Korematsu, K. (Kogakuin University, Tokyo (Japan)); Watabe, M.; Saika, T.; Iizuka, H.; Kitada, T.; Muramatsu, S. 22 Jul 1992. 320p. (In Japanese). From 1. meeting of The Japan Institute of Energy and the 70th Foundation anniversary meeting; Tokyo (Japan); 22-24 Jul 1992. In *Proceedings of the 1st Meeting of the Japan Institute of Energy and the 70th Foundation Anniversary Meeting.* Order Number DE93793523. Source: OSTI; NTIS (US Sales Only).

The contribution of automobiles to CO2 discharge in Japan reaches almost 18%. Under an assumption that an absorber is installed in the exhaust system in an automobile as one method to reduce CO2 emission, a test was given on emission reduction using absorbent liquids. As a preliminary test, CO2 was passed through several kinds of absorbent liquid including NaOH Na2CO3 and K2CO3 to measure CO2 amount before and after absorption. From the result, mono-ethanol amine (MEA) was selected. An absorbing device containing MEA aqueous solution (with a concentration of 2 or 4 mol/l and at an amount of 50 liters or 100 liters) was connected to an exhaust system, and a city driving experiment was carried out. As a result of measuring the CO2 concentration of the solution at every 10 km, the solution absorption pattern was such that it absorbed about 80% of the emission amount in a drive distance of up to 80 km, and lost the absorption activity at a distance of 120 km when 100 liter solution of 4mol/l was used. Even this simple device was verified to exhibit an effect of emission reduction. 2 refs., 4 figs., 1 tab.

23876 (CONF-9207203–, pp. 255-258) **Catalytic engine.** Yagi, M. (Advanced Combustion Engineering Institute, Tokyo (Japan)); Tsujimura, K. 22 Jul 1992. 320p. (In Japanese). From 1. meeting of The Japan Institute of Energy and the 70th Foundation anniversary meeting; Tokyo (Japan); 22-24 Jul 1992. In *Proceedings of the 1st Meeting of the Japan Institute of Energy and the 70th Foundation Anniversary Meeting.* Order Number DE93793523. Source: OSTI; NTIS (US Sales Only).

This paper proposes a new system concept to try a large reduction in exhaust emission from a combustion process in a diesel engine by utilizing catalytic chemistry, and reports study situations in technologies for basic reactions as the core of the concept. This system consists of a reforming device to generate H2 from partial oxidation of light oil, an H2 separating device, an NH3 synthesizing device, an NH3 storing device, an NH3 adsorbing device, an NOx reducing device, and a CO gas injecting device. It is intended to use NH3 synthesized from light oil using the above system as a reducing agent for NOx. While macromolecular hollow fiber membranes were used to separate H2 from CO in the gas generated from partial combustion, Pd membranes are also being given discussions. The NH3 synthesis used an Ru/Cs2 O/Al2O3 catalyst, which was proved strong against CO poisoning under normal pressure reaction. The NOx reduction used a vanadium catalyst, which showed very high reducing rates and durability in a driving experiment and exhibited a possibility of application. 3 refs., 5 figs., 2 tabs.

23877 (CONF-9207203–, pp. 259-260) **Study in deNOx catalysts for lean-burn gas engines.** Takahashi, I. (Tokyo Gas Co. Ltd., Tokyo (Japan)); Yamaseki, K.; Uchida, H. 22 Jul 1992. 320p. (In Japanese). From 1. meeting of The Japan Institute of Energy and the 70th Foundation anniversary meeting; Tokyo (Japan); 22-24 Jul 1992. In *Proceedings of the 1st Meeting of the Japan Institute of Energy and the 70th Foundation Anniversary Meeting.* Order Number DE93793523. Source: OSTI; NTIS (US Sales Only).

Development is being moved forward on a lean-burn gas engine using as a fuel the natural gas, a clean energy. This paper describes investigations on performance of metal loaded Mordenite catalyst as an NOx removing catalyst for such an engine by using simulated exhaust gas containing an abundance of oxygen and steam. The catalyst was prepared with different metals (Co, Rh, Pd, Ag, Cu, and Fe) using an ion-exchange or impregnation process. The exhaust gas composition was composed of predetermined amounts of NO, CO, CO2, O2, and H2O added with CH4 or

city gas or C3H6 at 0 to 3000 ppm. The gas was reacted in a fixed bed flow reactor at 673 K and under SV = 44000/h, where the following findings were obtained: in the case where hydrocarbon is CH4, the metal loaded Mordenite showed NOx removing activity, and the Co catalyst showed the highest NOx removal rate. Adding a city gas in place of the hydrocarbon improved the NOx removal rate. 2 refs., 2 tabs.

23878 (CONF-9207203–, pp. 277-280) **Selective reduction of nitrogen oxide over metal ion-exchanged silicoaluminophosphate (SAPO) catalysts.** Takita, Y. (Oita University, Oita (Japan). Faculty of Engineering); Kagawa, M.; Mizuhara, Y.; Ishihara, T. 22 Jul 1992. 320p. (In Japanese). From 1. meeting of The Japan Institute of Energy and the 70th Foundation anniversary meeting; Tokyo (Japan); 22-24 Jul 1992. In *Proceedings of the 1st Meeting of the Japan Institute of Energy and the 70th Foundation Anniversary Meeting.* Order Number DE93793523. Source: OSTI; NTIS (US Sales Only).

Silicoaluminophosphate(SAPO) is porus material having a crystalline structure similar to that of zeolite and it was shown in the study up to the previous report that Cu-SAPO-34 has a very high activity for selective reduction of NOx. The present paper discusses its resistance to heat and describes the results of an investigation on the selective reduction of NOx in an oxidizing atmosphere using C3 H6 as reductant over SAPO-34 ion-exchanged with various metals. In addition, MeAPSO-34 obtained by introducing metallic atoms into the lattice of SAPO-34 was investigated. Heat-resistance of metal ion-exchanged SAPO was judged by examining the change of its selective reduction activity for NO after it is subjected to heat treatment over 500-800°C in humidified atmosphere. While its activity is decreased by heat-treatment, it exhibited heat resistance superior to other kinds of catalysts(ZSM-5). It was found that introduction of metallic atoms into a lattice gives a high activity for disintegrating NO irrespective of a small amount of metal. 5 refs., 5 figs.

23879 (CONF-9207203–, pp. 281-282) **Selective reduction of nitrogen monoxide in oxidizing atmosphere over transition metal ion-exchanged zeolite catalysts.** Mizuno, N. (Hokkaido University, Sapporo (Japan). Catalysis Research Center); Yahiro, H.; Iwamoto, M. 22 Jul 1992. 320p. (In Japanese). From 1. meeting of The Japan Institute of Energy and the 70th Foundation anniversary meeting; Tokyo (Japan); 22-24 Jul 1992. In *Proceedings of the 1st Meeting of the Japan Institute of Energy and the 70th Foundation Anniversary Meeting.* Order Number DE93793523. Source: OSTI; NTIS (US Sales Only).

Use of a ternary catalyst for removing NO in the exhaust gas of diesel engines or lean-burn gasoline engines has been difficult because of high concentration of remaining oxygen. The present report describes the results of an investigation on the selective reducing reaction of NO by ethene on various transition metal ion-exchanged zeolite catalysts. The catalysts were prepared by the ordinary method and ZSM-5 (abbreviated to Z) or the like were used as zeolite matrix. Measurements were carried out in the range of 473-973K for the ordinary-pressure circulation of 1000ppm NO, 250ppm C2H4, and 2% O2. The reaction on a cation-exchanged Z showed that the active temperature region for NO removal changes greatly depending on the species of the cation and Cu, Co, H, Ag and Zn gave high removal rates; especially the activity of Cu-Z was high at the lowest temperature. Cu-Z 105(ion-exchange rate) showed adaptability to high GHSV and resistances to water vapor and SO2. 10 refs., 1 fig., 1 tab.

23880 (CONF-9207203–, pp. 283-286) **Selective reducing reaction of NO using zeolite-based catalyst.** Yogo, K. (Waseda University, Tokyo (Japan). School of Science and Engineering); Ihara, M.; Umeno, M.; Terasaki, I.; Watanabe, H.; Kikuchi, E. 22 Jul 1992. 320p. (In Japanese). From 1. meeting of The Japan Institute of Energy and the 70th Foundation anniversary meeting; Tokyo (Japan); 22-24 Jul 1992. In *Proceedings of the 1st Meeting of the Japan Institute of Energy and the 70th Foundation Anniversary Meeting.* Order Number DE93793523. Source: OSTI; NTIS (US Sales Only).

Since priority is given to the reaction between hydrocarbon and oxygen in diesel engine exhaust gas or the like where oxygen concentration is high and the selective reduction of NO is difficult, the development of catalyst of superior quality is getting important. This paper describes the results of a study on the reaction in which C2H4 rich in automobile exhaust gas is used as reductant using a Ga-loading zeolite catalyst. Several kinds of catalysts including ZSM-5 were investigated. The reaction was carried out in the conditions that the reaction temperature is 300-600°C; the concentrations of NO, C3H8 and C2H4, and O2 are 1000ppm, 167-1000ppm and 2.1%, respectively. A high NO removal rate of Ga-ZSM-5(the figure shows ion-exchange rate) was recognized over a wide range of temperature compared with the case where Cu or other species of metal were used. Even when the loading amount of Ga was increased upto 6wt.%, no change was found in NO conversion rate. This catalyst shows a high NO conversion rate compared with Cu-ZSM-5 in a high SV condition. 5 refs., 4 figs.

23881 (CONF-9207203–, pp. 287-290) **Selective reduction of NO on noble metal supported catalysts.** Oi, A. (National Institute for Resources and Environment, Tsukuba (Japan)); Obuchi, A.; Nakamura, M.; Ogata, A.; Mizuno, K.; Ouchi, H. 22 Jul 1992. 320p. (In Japanese). From 1. meeting of The Japan Institute of Energy and the 70th Foundation anniversary meeting; Tokyo (Japan); 22-24 Jul 1992. In *Proceedings of the 1st Meeting of the Japan Institute of Energy and the 70th Foundation Anniversary Meeting.* Order Number DE93793523. Source: OSTI; NTIS (US Sales Only).

Various kinds of catalysts are actively reported for reducing NO in the conditions of excessive oxygen as in diesel engine exhaust gas. The present report describes the results of an examination on the activity of noble metal supported catalysts for selective reduction of NO using mock-up gas and actual diesel exhaust gas. The catalysts used were prepared by supporting basically 1% of Rh, Ru, Pd, Ir and Pt on respective powdery-γ -alumina carriers. The reaction gas is composed of 995ppm of NO, 870ppm of C3H8, 5% of O2 and the balance He, and used for the examination at 200-400°C. Besides, an activity test using actual exhaust gas was carried out. Summarized conclusions are as follows Catalysts supporting noble metal including Pt exhibit a comparatively high activity in actual exhaust gas test and the drop of activities was slight after a five-hour continuous test. It is however supposed from the results of test using a mock-up gas that N2O is generated. Improvement in this respect was judged to be necessary. 8 figs.

23882 (UCRL-JC–111555) **Pulsed plasma processing for control of diesel engine emissions.** Vogtlin, G.E.; Freytag, E.K.; Bardsley, J.N.; Wallman, H. Lawrence Livermore National Lab., CA (United States). 12 Feb 1993. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9211101–8: Annual automotive development technology contractors' coordination meeting, Dearborn, MI (United States), 2-5 Nov 1992). Order Number DE93011884. Source: OSTI; NTIS; GPO Dep.

Electrical discharges can be used as an after treatment for diesel exhaust. We are presently involved in research to determine the feasibility of this process. These discharges have been shown to remove nitric oxide, sulfur dioxide, particulates and many organic compounds. A key issue is the efficiency of this removal since it effects both capital and operating costs. These discharges must be of short duration, less than one microsecond, to avoid energy losses due to heating of bulk gas molecules. The voltage must be kept below the voltage breakdown limit where ion heating creates an arc discharge. The basic process is the acceleration of electrons which then collide with gas molecules to form radicals such as O and OH. These radicals then react with and eliminate pollutants. Two basic electrode geometries are used to generate these discharges. The barrier discharge is when one or both of the electrodes is insulated and the pulse length is limited by charging of the insulator. This discharge must be driven by alternating current to permit alternating charging of the insulator. The other geometry is when one electrode has a peak voltage stress five or more times the average stress. We have been investigating the high stress geometry which uses a small wire inside a pipe. The principal experimental apparatus utilized by this effort uses a closed loop gas system. This system permits the production of various gas combinations prior to testing. Analysis can be conducted during or after these tests. The recirculated gas can be heated up to 400 degrees Fahrenheit. This system can measure the energy

used and the pollutant removal to determine efficiency. Our primarily goal is the simultaneous removal of nitric oxide and particulates typical of diesel exhaust. This is expected to be accomplished in one or more metal tubes no larger than two inches in diameter and thirty-six inches long.

3308 Alternative Fuels

Refer also to citation(s) 22697, 22698, 23216, 23855

23883 (BNL–48685) **Low pressure storage of natural gas on activated carbon.** Wegrzyn, J.; Wiesmann, H.; Lee, T. Brookhaven National Lab., Upton, NY (United States). [1992]. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-9211240–1: 1992 annual Automotive Technology Development Contractors' Coordination meeting (ATD/CCM), Dearborn, MI (United States), 2-5 Nov 1992). Order Number DE93014053. Source: OSTI; NTIS; GPO Dep.

The introduction of natural gas to the transportation energy sector offers the possibility of displacing imported oil with an indigenous fuel. The barrier to the acceptance of natural gas vehicles (NGV) is the limited driving range due to the technical difficulties of on-board storage of a gaseous fuel. In spite of this barrier, compressed natural gas (CNG) vehicles are today being successfully introduced into the market place. The purpose of this work is to demonstrate an adsorbent natural gas (ANG) storage system as a viable alternative to CNG storage. It can be argued that low pressure ANG has reached near parity with CNG, since the storage capacity of CNG (2400 psi) is rated at 190 V/V, while low pressure ANG (500 psi) has reached storage capacities of 180 V/V in the laboratory. A program, which extends laboratory results to a full-scale vehicle test, is necessary before ANG technology will receive widespread acceptance. The objective of this program is to field test a 150 V/V ANG vehicle in FY 1994. As a start towards this goal, carbon adsorbents have been screened by Brookhaven for their potential use in a natural gas storage system. This paper reports on one such carbon, trade name Maxsorb, manufactured by Kansai Coke under an Amoco license.

23884 (DOE/PC–93007525, pp. 26-33) **Oxygenate liquid transportation fuels.** USDOE Pittsburgh Energy Technology Center, PA (United States). 1993. In *PETC Review: Issue 7, Winter 1992–1993.* 52p. Order Number DE93007525. Source: OSTI; NTIS.

Almost one-half of the American population lives in cities that currently do not meet the EPA standard for ozone, a major contributor to urban smog that results from reactions of automobile emissions in the atmosphere under the influence of sunlight. Previous approaches to controlling automobile emissions have focused almost exclusively on redesigning the engine and exhaust system. The Clean Air Act Amendments of 1990 expanded that focus to include investigating alternative fuels for internal combustion engines because there are fuels that burn more completely and efficiently than do conventional gasoline and diesel fuels and are, therefore, much less polluting. In addition to the Clean Air Act Amendments, another law - the Alternative Motor Fuels Act (AMFA) of 1988 - has a its purpose to help achieve energy security, improve air quality, and encourage the production of methanol-, ethanol-, and natural-gas powered motor vehicles by encouraging the development and widespread consumer use of methanol, ethanol, and natural gas as transportation fuels. Many potentially clean vehicle fuels have been identified, including natural gas, hydrogen, propane, and electricity. Each of these has advantages but none appears to be readily available for the mass market. Nevertheless, one group of clean fuels - the oxygenate liquid transportation fuels, or oxygenates - does seem to offer immediate short-term benefits and can be produced from coal. The advantages of these fuels are discussed.

23885 (NREL/TP–422-5259) **Biodiesel/Aquatic Species Project report, FY 1992.** Brown, L. (National Renewable Energy Lab., Golden, CO (United States)); Jarvis, E.; Dunahay, T.; Roessler, P.; Zeiler, K.; Sprague, S. National Renewable Energy Lab., Golden, CO (United States). May 1993. 33p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-83CH10093. Order Number DE93010024. Source: OSTI; NTIS; GPO Dep.

The primary goal of the Biodiesel/Aquatic Species Project is to develop the technology for growing microalgae as a renewable biomass feedstock for the production of a diesel fuel substitute (biodiesel), thereby reducing the need for imported petroleum. Microalgae are of interest as a feedstock because of their high growth rates and tolerance to varying environmental conditions, and because the oils (lipids) they produce can be extracted and converted to substitute petroleum fuels such as biodiesel. Microalgae can be grown in arid and semi-arid regions with poor soil quality, and saline water from aquifers or the ocean can be used for growing microalgae. Biodiesel is an extremely attractive candidate to fulfill the need for a diesel fuel substitute. Biodiesel is a cleaner fuel than petroleum diesel; it is virtually free of sulfur, and emissions of hydrocarbons, carbon monoxide, and particulates during combustion are significantly reduced in comparison to emissions from petroleum diesel. Biodiesel provides essentially the same energy content and power output as petroleum-based diesel fuel.

35 ARMS CONTROL

23886 (SAND–93-1027C) **Waste component recycle, treatment, and disposal integrated demonstration (WeDID) nuclear weapon dismantlement activities.** Wheelis, W.T. Sandia National Labs., Albuquerque, NM (United States). 12 Apr 1993. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-930483–4: 9. waste minimization and pollution prevention conference, San Francisco, CA (United States), 13-15 Apr 1993). Order Number DE93012862. Source: OSTI; NTIS; INIS; GPO Dep.

One of the drivers in the dismantlement and disposal of nuclear weapon components is Envirorunental Protection Agency (EPA) guidelines. The primary regulatory driver for these components is the Resource Conservation Recovery Act (RCRA). Nuclear weapon components are heterogeneous and contain a number of hazardous materials including heavy metals, PCB'S, selfcontained explosives, radioactive materials, gas-filled tubes, etc. The Waste Component Recycle, Treatment, Disposal and Integrated Demonstration (WeDID) is a Department of Energy (DOE) Environmental Restoration and Waste Management (ERWM) sponsored program. It also supports DOE Defense Program (DP) dismantlement activities. The goal of WeDID is to demonstrate the end-to-end disposal process for Sandia National Laboratories designed nuclear weapon components. One of the primary objectives of WeDID is to develop and demonstrate advanced system treatment technologies that will allow DOE to continue dismantlement and disposal unhindered even as environmental regulations become more stringent. WeDID is also demonstrating waste minimization techniques by recycling a significant weight percentage of the bulk/precious metals found in weapon components and by destroying the organic materials typically found in these components. WeDID is concentrating on demonstrating technologies that are regulatory compliant, are cost effective, technologically robust, and are near-term to ensure the support of DOE dismantlement time lines. The waste minimization technologies being demonstrated by WeDID are cross cutting and should be able to support a number of ERWM programs.

23887 (UCRL-ID–108162) **The utility and role of treaties in Nuclear Arms Control.** Greb, A. Lawrence Livermore National Lab., CA (United States). Aug 1991. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE93012449. Source: OSTI; NTIS; GPO Dep.

This report contains information on research projects and activities for the period 1989-1990. The compilation of abstracts and attachments contain information on the historical aspects of US decision making on arms control, the peaceful uses of nuclear explosives, and the value of the Limited Test Ban Treaty. Also, a draft proposal for a workshop on the subject of National Security Decision Making in the 1950s is included.

3501 Policy, Negotiations, and Legislation

23888 (INIS-mf–13520) **Disarmament. Newsletter. V. 11, no. 1.** United Nations, New York, NY (USA). Dept. for Disarmament Affairs. Feb 1993. [16p.] Order Number DE93624714. Source: OSTI; NTIS (US Sales Only); INIS.

The newsletter presents materials covering the following subjects: signing of START 2 treaty by Russia and the United States; arms regulation and disarmament in the post-cold war area; accession of new countries to the Non-Proliferation Treaty; trends towards fewer nuclear-weapon tests.

23889 (SAIC–93011823) **Trends and developments in the proliferation of ballistic missiles and weapons of mass destruction seminar, February 17, 1993: Final report.** Murray, B.L.; Hallenbeck, R.A.; Gill, J.M. Science Applications International Corp., McLean, VA (United States). 8 Apr 1993. 42p. Sponsored by USDOE, Washington, DC (United States); Department of Defense, Washington, DC (United States); Arms Control and Disarmament Agency, Washington, DC (United States). Order Number DE93011823. Source: OSTI; NTIS; GPO Dep.

This seminar provided an overview on the proliferation of nuclear, chemical and biological weapons as well as missiles and missile technology, and set the stage for subsequent seminar meetings of the 1993 program. A multiplicity of factors – different nations, regions, and capabilities – is making dealing with proliferation increasingly complicated. Additionally, recent or upcoming world events introduce further uncertainty into proliferation calculations. These proliferation accelerators and decelerators, will greatly shape and define the overall proliferation picture. These factors combine to raise a whole new series of stability issues which require new analyses and approaches for managing proliferation in the post-Cold War era. While technology cannot alone solve the proliferation problem, a particularly promising application is in new information technologies and interactive information management systems. A proliferation information network could be used to fuse large amounts of information and data on exports; license; treaty reporting, notifications, and other obligations; dual use technologies and related scientific advances; and others information of proliferation relevance. This type of network could use readily available technologies, would be simple to use and relatively inexpensive to create and maintain, and could be made available to almost of all of the nations of the world.

3502 Proliferation

Refer also to citation(s) 24559

23890 (DOE/AN/ACNT–92C) **Arms control and nonproliferation technologies: Fourth quarter 1992.** Staehle, G.; Talaber, C.; Stull, S. Lawrence Livermore National Lab., CA (United States). 1992. 35p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE93010998. Source: OSTI; NTIS; GPO Dep.

This report includes information concerning: the Department of Energy's Office of Arms Control and Nonproliferation; the nuclear inspections in Iraq, lessons for verification; detection technologies needed for each step of nuclear weapon development; nuclear proliferation problems; strengthening the nuclear reactor fuel cycle against proliferation; monitoring using unattended remote nondestructive assay; seismic monitoring in a proliferation environment; forensic science center, remote infrared spectrometry for nonproliferation applications; and acoustic instrument for identifying chemical munitions.

23891 (UCRL-ID–111040) **Potential CIS/Russian targets.** Speed, R.D. Lawrence Livermore National Lab., CA (United States). Jun 1992. 24p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE93012441. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This paper (based on the limited unclassified literature available) describes potential target sets in the Commonwealth of Independent States (CIS) and Russia. If in the future the CIS or Russia should revert to a posture of hostility, it is estimated that the capability to deliver on target a few hundred nuclear weapons should be sufficient for deterrence.

23892 (UCRL-ID–111207) **Non-proliferation and GPALS: The French and German views.** Zinner, P.E. Lawrence Livermore National Lab., CA (United States). Jun 1992. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE93012443. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The purpose of this report is to record and analyze attitudes in France and Germany toward nuclear proliferation and register reactions in the two countries to a US initiative designed to enlist their support for the development and deployment of GPALS (Global Protection Against Limited Strikes). The data for this report was collected in personal interviews I conducted during March 1992 in France and Germany. My respondents included government officials, military personnel (in Germany only), and knowledgeable experts outside government service. In addition, I perused numerous French and German language daily newspapers, periodicals, and research publications.

3503 Verification

23893 (LA–12546-MS) **Instrumentation and procedures for moisture corrections to passive neutron coincidence counting assays of bulk PuO_2 and MOX powders.** Stewart, J.E. (Los Alamos National Lab., NM (United States)); Menlove, H.O.; Ferran, R.R.; Aparo, M.; Zeppa, P.; Troiani, F. Los Alamos National Lab., NM (United States); ENEA, Saluggia (Italy). Centro Ricerche Energia. May 1993. 33p. Sponsored by USDOE, Washington, DC (United States); Nuclear Regulatory Commission, Washington, DC (United States); Department of State, Washington, DC (United States); Arms Control and Disarmament Agency, Washington, DC (United States). DOE Contract W-7405-ENG-36. (ISPO–351). Order Number DE93013599. Source: OSTI; NTIS; INIS; GPO Dep.

For passive neutron-coincidence-counting verification measurements of PuO_2 and MOX powder, assay biases have been observed that result from moisture entrained in the sample. This report describes a unique set of experiments in which MOX samples, with a range of moisture concentrations, were produced and used to calibrate and evaluate two prototype moisture monitors. A new procedure for moisture corrections to PuO_2 and MOX verification measurements yields MOX assays accurate to 1.5% (1σ) for 0.6- and 1.1-kg samples. Monte Carlo simulations were used to extend the measured moisture calibration data to higher sample masses. A conceptual design for a high-efficiency neutron coincidence counter with improved sensitivity to moisture is also presented.

23894 **Detection device for high explosives.** Grey, A.E.; Partin, J.K.; Stone, M.L.; Von Wandruslka, R.M. To Dept. of Energy. 1991. Filed date 28 May 1991. USA patent application 7-707,414. 46p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-76ID01570. Order Number DE93011994. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This invention is comprised of a portable fiber optic detector that senses the presence of specific target chemicals by electrostatically attracting the target chemical to an aromatic compound coating on an optical fiber. Attaching the target chemical to the coated fiber reduces the fluorescence so that a photon sensing detector records the reduced light level and activates an appropriate alarm or indicator.

23895 (SAND–93-1125C) **The Authenticated Tracking and Monitoring System (ATMS) concept.** Schoeneman, J.L.; Fox, L.J.; Jenkins, C.D. Sandia National Labs., Albuquerque, NM (United States). Apr 1993. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-930533–1: 15. annual symposium of the European Safeguards Research and Development Association: safeguards and nuclear materials management, Rome (Italy), 11-13 May 1993). Order Number DE93013775. Source: OSTI; NTIS; GPO Dep.

One of the proposed applications of the satellite-based Global Verification and Location System (GVLS) is the Authenticated Tracking and Monitoring System (ATMS). When fully developed, ATMS will provide the capability to monitor, in a secure and authenticated fashion, the status and global tracking of selected items while in transit - in particular, proliferation sensitive items. The

resulting tracking, timing, and status information can then be processed and utilized to assure compliance with, for example, various treaties. Selected items to be monitored could include, but are not limited to, Treaty Limited Items (TLIs), such as nuclear weapon components, Re-entry Vehicles (RVs), weapon delivery and launch systems, chemical and biological agents, Special Nuclear Material (SNM), and related nuclear weapons manufacturing equipment. The ATMS has potential applications in the areas of arms control, disarmament and Non-proliferation treaty verification, military asset control, as well as International Atomic Energy Agency (IAEA) and Euratom safeguards monitoring activities. The concept presented here is mainly focused on a monitoring technology for proliferation sensitive items. It should, however, be noted that the systems potential applications are numerous and broad in scope, and could easily be applied to other types of monitoring activities as well.

23896 (UCRL-ID–112025) **An approach for using data supplied by the former Soviet Union to improve US treaty monitoring.** Buonpane, L.; Sicherman, A. Lawrence Livermore National Lab., CA (United States). Nov 1992. 33p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE93012391. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Improvements in the Unites States' capability to monitor nuclear test ban treaties may be possible through judicious use of data supplied by the former Soviet Union. However, such data obtained through treaty mandated data exchanges or other means is of questionable validity. Thus, there are potential risks as well as benefits of incorporating such data into US monitoring techniques. In general, to make use of unverified data, we desire a quantitative approach that recognizes both the risks and the benefits. This paper presents a method for using data supplied by the former Soviet Union to improve nuclear test ban treaty verification. Specifically, we focus on Soviet-supplied test yields to refine the US estimate of a key parameter in the seismic magnitude-yield relationship used in verifying nuclear testing treaties (e.g., Threshold Test Ban Treaty, or TTBT). This paper provides background on the magnitude-yield equation and the potential risks and benefits of incorporating Soviet data. And it describes a classical statistics approach for dealing with Soviet data using a sequence of hypothesis tests. We present an innovative Bayesian approach having similarities to but key advantages over the classical statistics method. A numerical example is used to illustrate each step of the Bayesian approach. Then, we summarize key features of the Bayesian approach, including more flexibility in treating Soviet data while still minimizing the impact of potentially suspicious data on parameter estimates. Application of the approach to other verification contexts is also discussed. The appendices expand on technical details of the approach referred to in the paper.

36 MATERIALS

Refer also to citation(s) 23492, 23599, 24085, 25226

23897 (ANL/MSD/CP–76872) **Synthesis and properties of nanophase materials.** Siegel, R.W. Argonne National Lab., IL (United States). Materials Science Div. Mar 1993. 25p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-921121–2: 3. joint conference of European East-West conference on materials and processes and European Materials Research Society fall meeting, Strasbourg (France), 3-6 Nov 1992). Order Number DE93011757. Source: OSTI; NTIS; GPO Dep.

Nanophase materials, with their grain sizes or phase dimensions in the nanometer size regime, are now being produced by a wide variety of synthesis and processing methods. The interest in these new ultrafine-grained materials results primarily from the special nature of their various physical, chemical, and mechanical properties and the possibilities to control these properties during the synthesis and subsequent processing procedures. Since it is now becoming increasingly apparent that their properties can be engineered effectively during synthesis and processing, and that they can also be produced in quantity, nanophase materials should have considerable potential for technological development in a variety of applications. Some of the recent research on nanophase materials related to their synthesis and properties is briefly reviewed and the future potential of these new materials is considered.

23898 (CONF-9209221–, pp. 1-41) **Positron spectroscopy for the study of materials.** Mills, A.P. Jr. (AT & T Bell Labs., Murray Hill, NJ (US)). Oak Ridge National Lab., TN (United States). Apr 1993. From Department of Energy (DOE) task force meeting workshop on the application of positron spectroscopy to materials sciences; Miranch Mirage, CA (United States); 9-11 Sep 1992. In *DOE workshop meeting on the application of positron spectroscopy to materials sciences: Proceedings.* 395p. Order Number DE93012784. Source: OSTI; NTIS.

The relation of the positron method to the neutron and x-ray techniques is considered, and the prospects for materials studies with intense positron sources are assessed. The goal of the deductive branch of experimental condensed matter and materials science is to know the states of a substance and thus to understand how to make beneficial modifications and applications. The probes used range from feebly interacting microscopes and diffractometers to strongly perturbative impurities; from susceptibility measurements in weak applied fields to the layer-by layer or sometimes total destruction of a sample. Compared to neutrons and X-ray photons, positrons being charged tend to interact rather strongly with a sample. Because of the greater amount of theory sometimes needed for interpretation and because of the small source intensities, positron experiments have often been neglected in favor of other methods. Part of such a prejucice is justifiable from the point of view of a materials scientist since often one is learning more about the system consisting of one positron plus a material than about the material itself. While experiments aimed at studying an impurity may be of fundamental or academic interest and could lead to future practical results, on should heed the famous question of Phil Platzman, "What are you doing that for?"

23899 (CONF-9209221–, pp. 69-89) **Present and future status of positrons in industrial research.** Tanigawa, Shoichiro (Univ. of Tsukuba, Ibaraki (JP)). Oak Ridge National Lab., TN (United States). Apr 1993. From Department of Energy (DOE) task force meeting workshop on the application of positron spectroscopy to materials sciences; Miranch Mirage, CA (United States); 9-11 Sep 1992. In *DOE workshop meeting on the application of positron spectroscopy to materials sciences: Proceedings.* 395p. Order Number DE93012784. Source: OSTI; NTIS.

The author reviews the present and future status of positrons in industrial research in Japan. At present the government views positron research as basic research, not having immediate applied benefits, and in todays political climate is funding work on positron sources. There is a large demand for probes which can study lattice defects near surfaces or interfaces, coming from materials engineering people. Characterization of surfaces and interfaces is of great interest. The appearance of slow and/or monoenergetic positron sources has made it possible to study defects. This feature of slow positrons has attracted the interest of industrial people, especially those working with semiconductor based devices. Recent guidelines on "Advanced Use of Radiations" in the atomic energy fund has resulted in JAERI starting work on plans for a positron factory. The rapid deployment of small cyclotrons for positron sources as part of positron CT devices in the medical field has attracted the notice of engineers in fields such as automobile manufacturing, where such techniques may aid in performance studies of engines. A major interest is in seeing more efficient moderation processes developed so that one can use sources below the 100 μCi level, which in sealed sources are not legally radioactive in Japan. This will allow the much more rapid deployment of positron techniques in industrial settings.

23900 (CONF-9209221–, pp. 95-109) **The application of positron spectroscopy to materials sciences the perspective from the Idaho National Engineering Laboratory.** Denison, A.B. (Idaho National Engineering Lab., ID (US)). Oak Ridge National Lab., TN (United States). Apr 1993. From Department of Energy (DOE) task force meeting workshop on the application of positron spectroscopy to materials sciences; Miranch Mirage, CA (United

States); 9-11 Sep 1992. In *DOE workshop meeting on the application of positron spectroscopy to materials sciences: Proceedings.* 395p. Order Number DE93012784. Source: OSTI; NTIS.

The demand for the development and processing of new types of sophisticated materials under a variety of uses and environments has placed a strain on the current technologies. This, coupled with a national effort (with DOE as a partner) to bring US industrial manufacturing technologies into a competitive posture internationally, requires the application of the best technical methods which can be developed. The unique behavior of the positron in materials makes it a valuable non-destructive probe of materials on a microscopic scale. Recent years have seen the development of positron beams and the positron microscope. Uses of such beams and the microscope have been shown to be sensitive probes of; defects in materials, surface studies valuable in many manufacturing and biological applications, thin film studies, metal aging and fatigue, and polymer and composite aging and fatigue. The microelectronics industry has indicated a definite interest in using highly resolved positron beams and microscopy for metal oxide defects, bonding integrity of circuit elements, and as a lithography tool in the mask making process. At INEL areas of interest include processing of vapor deposited metal coatings, and mechanically formed alloys which possess superior strength and reliability. Laboratory and experimental studies have shown the method of positron microscopy is limited by available intensity and resolution. An overall effort is needed to design and provide intense sources. The author argues for the role INEL could provide in developing such facilities. A beam facility has been designed capable of producing 10^{12} slow mono-energetic e^+/s at 5 keV over a 0.03cm diameter beam size. The beam is tailored to be accepted by a positron microscope. The design effort has been carried out in conjunction with the positron microscope research group at the U of Michigan.

23901 (CONF-9209221–, pp. 111-129) **The application of positron spectroscopy to materials science in China.** Wang, S.J. (Wuhan Univ. (CN)). Oak Ridge National Lab., TN (United States). Apr 1993. From Department of Energy (DOE) task force meeting workshop on the application of positron spectroscopy to materials sciences; Miranch Mirage, CA (United States); 9-11 Sep 1992. In *DOE workshop meeting on the application of positron spectroscopy to materials sciences: Proceedings.* 395p. Order Number DE93012784. Source: OSTI; NTIS.

The positron annihilation spectroscopy is widely used to investigate the material properties in China. The main fields are metals and alloys, semiconductors, polymers, high-$T_c$superconductors. The special attention is paid for some novel material with practical application. Chinese researchers measured the positron annihilation parameters of materials in various states and then correlated with the material properties.

23902 (CONF-9209221–, pp. 224-236) **Positron microscopy in materials sciences.** Gidley, D. (Univ. of Michigan, Ann Arbor (US)); Frieze, W.; DeMaggio, G.; Dull, T.; Yu, E. Oak Ridge National Lab., TN (United States). Apr 1993. From Department of Energy (DOE) task force meeting workshop on the application of positron spectroscopy to materials sciences; Miranch Mirage, CA (United States); 9-11 Sep 1992. In *DOE workshop meeting on the application of positron spectroscopy to materials sciences: Proceedings.* 395p. Order Number DE93012784. Source: OSTI; NTIS.

In assessing how the fields in materials sciences can best employ existing and emerging positron methodologies the authors concentrate on microscopic techniques and applications. From a historical perspective this is logical. Before the advent of focussed beams of positrons, beta-decay sources with broad energy distribution were used in the 1960's and 70's to study the momentum and spatial distributions of electrons undergoing annihilation in bulk samples. Variable energy positron beams have allowed us in the 1980's to not only extend these techniques to surfaces, thin films, and interfaces (and the depth profiling thereof), but also to add new techniques such as reemitted positron and positronium spectroscopy, low energy positron diffraction, and positron-annihilation induced Auger spectroscopy. The addition of microscopic lateral resolution to all of the above techniques should be the next extension in beams for the 90's. The authors will briefly discuss the operational modes of a positron microscopy, dividing them into two basic types: the reemitted positron microscopy and the scanning microprobe. For reemission microscopy image contrast is determined by any target property that affects the probability, energy, or angle of positron reemission, e.g. trapping in surface and near surface defects, changes in material composition, and blocking by surface overlayers. In scanning mode contrast is determined by local structure that affects the particular positron signal employed; typically Doppler broadening or angular correlation of the annihilation gammas, fraction of reemitted positrons or positronium, or the positron lifetime spectrum.

23903 (CONF-9209221–, pp. 237-251) **Positron annihilation in materials science with a pulsed positron beam of variable energy.** Trifshaeuser, W. (Universitaet der Bundeswehr Muenchen, Neubiberg (DE)). Oak Ridge National Lab., TN (United States). Apr 1993. From Department of Energy (DOE) task force meeting workshop on the application of positron spectroscopy to materials sciences; Miranch Mirage, CA (United States); 9-11 Sep 1992. In *DOE workshop meeting on the application of positron spectroscopy to materials sciences: Proceedings.* 395p. Order Number DE93012784. Source: OSTI; NTIS.

Positrons are very sensitive probes for vacancy type defects of atomic dimensions, e.g. vacancies, vacancy agglomerates, voids, dislocations. It is well established that positrons can be trapped at these defects and because of the locally reduced electron density the lifetime of the positron localized at the defect increases. Since it is possible to determine up to four different lifetime spectrum, it is possible to separate out various atomic defect configurations and concentrations, which may be present simultaneously, with very high sensitivity (≈1 ppm) and in a nondestructive way. The conventional lifetime method with positrons from a radioactive isotope (positron energies up to about 600 keV) and hence ranges of the fast positrons of 50-1000 μm, can give only information for defect distributions of macroscopic regions or an average defect structure. Monoenergetic positrons of low and variable energy (1 keV to 30 keV), however, can sample near surface regions and layered structures in a much more detailed and also nondestructive manner. The principle and the set up of such a system as well as experimental results will be presented and discussed. With the present pulsed system (≈3 mm beam diameter) planar pure surfaces, coated and laser treated surfaces of metals, alloys and semiconductors have been or are being studied. With this depth profiling also interfaces of oxides and semiconductors can be investigated. The typical textures of technical alloys or the dimensions of functional units in microelectronic devices, however, are in the range of micrometers. Therefore for many applications in materials science a positron beam diameter in the micrometer range is desirable and necessary. This will lead to a scanning positron microscope consisting of a pulsed positron beam (~1 μm diameter) of variable energy (500 eV to 30 keV) with a scanning facility of the beam. A possible design of such a system will be presented and discussed.

23904 (CONF-9209221–, pp. 253-272) **Positron annihilation induced auger electron spectroscopy.** Weiss, A. (Univ. of Texas, Arlington (US)); Fazleev, N.; Kim, J.H.; Jensen, K.H.; Koymen, A.R.; Lee, K.H.; Tyan G., L.W.; Yang, Y.S.; Zhou, H.Q. Oak Ridge National Lab., TN (United States). Apr 1993. From Department of Energy (DOE) task force meeting workshop on the application of positron spectroscopy to materials sciences; Miranch Mirage, CA (United States); 9-11 Sep 1992. In *DOE workshop meeting on the application of positron spectroscopy to materials sciences: Proceedings.* 395p. Order Number DE93012784. Source: OSTI; NTIS.

Positron Annihilation Induced Auger Electron Spectroscopy (PAES) makes use of a new mechanism for the excitation of Auger transitions in which a beam of low energy positrons is used to create the necessary core-hole excitations by annihilating core electrons. This mechanism gives PAES a number of significant advantages over conventional methods of Auger spectroscopy. Because the incident positron beam energy need not be larger than the core level ionization energy, (as is the case in conventional Electron induced Auger Electron Spectroscopy (EAES)). PAES spectra can be obtained using very low (less than 30eV) incident beam energies. This makes is possible to eliminate the very large collisionally induced secondary electron background which plagues

EAES. In addition, the positron Auger signal originates almost exclusively from the topmost atomic layer due to the fact that the positrons annihilating with the core electrons are trapped in an image correlation well just outside the surface. In this talk, the results of experiments on clean and adsorbate covered surfaces are reported which demonstrate the extremely low background, and increased surface sensitivity that is possible with PAES. Next the authors will describe experiments in which PAES has been applied to the study of the growth, alloying and inter-diffusion of ultrathin layers of Pd and Au on Cu and Si substrates. They conclude with a discussion of future applications of PAES including studies of surface magnetism using Polarized Positron annihilation induced Auger Electron Spectroscopy (P-PAES) and the use of a time delayed signal to permit microprobe PAES analysis using kilovolt positron beams.

23905 (CONF-9209221–, pp. 273-290) **Present status of design study for the positron factory.** Okada, Sohei (Japan Atomic Energy Research Institute, Takasaki (JP)). Oak Ridge National Lab., TN (United States). Apr 1993. From Department of Energy (DOE) task force meeting workshop on the application of positron spectroscopy to materials sciences; Miranch Mirage, CA (United States); 9-11 Sep 1992. In *DOE workshop meeting on the application of positron spectroscopy to materials sciences: Proceedings.* 395p. Order Number DE93012784. Source: OSTI; NTIS.

The Japan Atomic Energy Research Institute, JAERI, has been promoting design studies for the "Positron Factory", in which linac-based intense monoenergetic positron beams are planned to be applied to advanced materials characterization and new fields of basic research. A tentative goal of the slow positron beam intensity is $10^{10}s^{-1}$. The design is based on a new target system, in which simultaneous multi-channel extraction of slow positron beams by multiple tungsten moderator assemblies is applied. This geometrical configuration will utilize excaping high-energy positrons from the first assembly again in the following ones. Slow positron reemission probabilities from the assemblies were evaluated using a Monte Carlo code named SPG (Slow Positron Generation) to simulate moderation, diffusion, annihilation and reemission of positrons. The conclusion was that energetic positrons ejected from the converter with energies less than 10 MeV are efficiently exploited for slow positron generation. Energies and angular distributions of energetic positrons from the tantalum converter were calculated for a wide range of incident electron energies (25 MeV to 2.5 GeV) and various converter thicknesses by using an electromagnetic cascade shower Monte Carlo code EGS4. The production efficiency of energetic positrons with energy less than 10 MeV and an ejection angle less than 20°, which are useful for generating slow positrons, was maximum at an electron energy of roughly 100 MeV. The conclusion is that the tentative goal of slow positron beam intensity may be attained, at least in the first moderator assembly. Actual slow positron yields in the rear assemblies will be less due to positron beam divergences, even if pulsed coil magnets are applied for focusing.

23906 (CONF-9209221–, pp. 291-316) **Positron annihilation in novel materials.** Jean, Y.C. (Univ. of Missouri, Kansas City (US)). Oak Ridge National Lab., TN (United States). Apr 1993. From Department of Energy (DOE) task force meeting workshop on the application of positron spectroscopy to materials sciences; Miranch Mirage, CA (United States); 9-11 Sep 1992. In *DOE workshop meeting on the application of positron spectroscopy to materials sciences: Proceedings.* 395p. Order Number DE93012784. Source: OSTI; NTIS.

In the past years, the University of Missouri, Kansas City has applied positron annihilation spectroscopy to study electronic properties and defect structures in various types of novel materials: high $T_c$superconductors, C_{60}-based superconductors, organics, and polymers. The ultimate goal of this research is to provide clues for the search for novel materials, which have technological significance and industrial applications. Research strategies are: (1) to prepare materials of the highest possible quality including complete physical and chemical characterizations of materials properties, (2) to perform positron experiments systematically, (3) to perform theoretical calculations for a thorough understanding of the obtained experimental results.

23907 (CONF-9209221–, pp. 355-363) **Theoretical aspects of positron annihilation in condensed matter.** Pickett, W.E. (Naval Research Lab., Washington, DC (US)). Oak Ridge National Lab., TN (United States). Apr 1993. From Department of Energy (DOE) task force meeting workshop on the application of positron spectroscopy to materials sciences; Miranch Mirage, CA (United States); 9-11 Sep 1992. In *DOE workshop meeting on the application of positron spectroscopy to materials sciences: Proceedings.* 395p. Order Number DE93012784. Source: OSTI; NTIS.

The annihilation of positrons with electrons in condensed matter provides a unique probe of solids. As a probe of the bulk material, it is insensitive to surface difficulties but is sensitive to structural inhomogeneties. Measurement of the two dimensional angular correlation of annihilation radiation (2D-ACAR) gives spectra containing detailed information about the electronic wavefunctions, and therefore the bonding of atoms in the solid. The standard way to interpret these electron-positron momentum densities is via comparison with local density band structure calculations. Sharp breaks in the momentum distribution reflect Fermi surfaces in metals, which are essential to know. Important questions about the techniques include: can experimental resolution be improved to allow the identification of the Fermi liquid renormalization factor Z^*? Can the method be used to identify the change in momentum distribution arising from the opening of the gap in the superconducting state (high temperature superconductors are encouraging in this regard)? Should there be more emphasis on identifying and interpreting the reciprocal form factor? These items will be addressed keeping in mind current capabilities and short-term possibilities.

23908 (CONF-9209221–, pp. 365-371) **[Application of positron annihilation spectroscopy].** Feldman, L. (AT & T Bell Labs, Murray Hill, NJ (US)). Oak Ridge National Lab., TN (United States). Apr 1993. From Department of Energy (DOE) task force meeting workshop on the application of positron spectroscopy to materials sciences; Miranch Mirage, CA (United States); 9-11 Sep 1992. In *DOE workshop meeting on the application of positron spectroscopy to materials sciences: Proceedings.* 395p. Order Number DE93012784. Source: OSTI; NTIS.

The author discusses an application of positron annihilation spectroscopy. Point defects in Si are determined to be less than $5 \times 10^{15}cm^{-3}$. Defect concentrations are of interest in Si MOSFET devices due to enhanced leakage currents. The author then comments on issues which conferees should consider in the process of developing positron spectroscopy into a materials science diagnostic. They include: compare results with other competing technologies; focus on measurements which the technique performs best; measure material properties. Measurements suggested include; band structure, interfaces; defect profiling near surfaces; precursors to macroscopic failure; band structure near defects; laminations and adhesion of metal/polymers, or metal/semiconductors; non-contact measurement of electrically active defects.

23909 (CONF-9209221–, pp. 373-376) **Potential applications of PAS techniques to industrial research in polymeric materials.** Yang, H. (Imaging Research Labs., Rochester, NY (US)). Oak Ridge National Lab., TN (United States). Apr 1993. From Department of Energy (DOE) task force meeting workshop on the application of positron spectroscopy to materials sciences; Miranch Mirage, CA (United States); 9-11 Sep 1992. In *DOE workshop meeting on the application of positron spectroscopy to materials sciences: Proceedings.* 395p. Order Number DE93012784. Source: OSTI; NTIS.

The author discusses different material science applications where positron annihilation spectroscopy can be applied to solve materials problems. These include the following topics. Study of photoconductors through examination of glass transitions, dipole moment measurements, measurement of free volume vs. mobility, and surface crystallization, defects, and crazing. Study of free volume changes in polymer blends as a function of mixing. Aging behaviour of materials; toughness transitioning to brittleness as a function of free volume. Study of failure in materials, looking at defect development from crazing to cracks to final failure. Properties of semicrystalline polymers. Study of surface and interface properties by examination of surface roughness, crazing, and defects.

This can also include measurement of interface thickness and adhesion. Study of crosslinked polymers by looking at free volume in relation to the microstructure and degree of inhomogeneties.

23910 (DOE/FTR–93012986) **[Travel to United Kingdom to attend and present a paper at the first European conference on smart structures and materials]: Foreign trip report, May 10–20, 1992.** Segalman, D.J. Sandia National Labs., Albuquerque, NM (United States). 10 Jun 1992. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. Order Number DE93012986. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The paper presented by the author, "Simulation of the Dynamic Behavior of Polymeric Gels" (bending of polyelectrolyte gels), was well received. The visit to De Rossi's laboratory revealed that he has performed many of the same experiments that the author has planned with polyacrylonitrile fibers; collaboration is possible. Primary focus of the papers at the conference was on application of old smart materials (fiber optics, piezoelectrics, aerospace, optics, sensors, actuators, controllers). (DLC)

23911 (ORNL/FMP–93/3) **Publications of the Fossil Energy Advanced Research and Technology Development Materials Program, April 1, 1991–March 31, 1993.** Carlson, P.T. (comp.). Oak Ridge National Lab., TN (United States). [1993]. 46p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93013097. Source: OSTI; NTIS; GPO Dep.

Objective of DOE's Fossil Energy Advanced Research and Technology Development Materials Program is to conduct research and development on materials for fossil energy applications, with focus on longer-term needs. The Program includes research aimed at a better understanding of materials behavior in fossil energy environments and on the development of new materials capable of substantial improvement in plant operations and reliability. Scope of the program addresses materials requirements for all fossil energy systems, including materials for coal preparation, coal liquefaction, coal gasification, heat engines and heat recovery, combustion systems, and fuel cells. Work on the Program is conducted at national and government laboratories, universities, and industrial research facilities. Research conducted on the Program is divided among the following areas: (1) ceramics, (2) new alloys, (3) corrosion research, and (4) program development and technology transfer. This bibliography covers the period of April 1, 1992, through March 31, 1993, and is a supplement to previous bibliographies in this series. The publications listed are limited to topical reports, open literature publications in refereed journals, full-length papers in published proceedings of conferences, full-length papers in unrefereed journals, and books and book articles.

23912 (ORNL/FTR–4165) **[Travel to Japan for the international symposium on ultra-high temperature materials]: Foreign trip report, November 30–December 9, 1991.** Huddleston, R.L. Oak Ridge National Lab., TN (United States). 23 Dec 1991. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93011056. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The traveler attended the "International Symposium on Ultra-High Temperature Materials" in Tajimi City, Japan, as one of three invited guest lecturers. The Symposium focused on materials technologies forapplications above 2000°C, with emphasis on aerospace (space plane, supersonic and hypersonic technologies, and rocket technology), energy (fusion reactor and supercritical thermal plants), and high-temperature material characterization. An independent visit was made to the Power Reactor and Nuclear Fuel Development Corporation (PNC), Oarai Engineering Center, Oarai, Japan, to discuss high-temperature structural design technology for liquid metal reactors and to tour the structural test capabilities in the Structural Engineering Section.

23913 (ORNL/M–2788) **ABSTRACTS: Seventh annual conference on fossil energy materials.** Oak Ridge National Lab., TN (United States). 1993. 43p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. (CONF-9305135–Absts.: 7. annual conference on fossil energy materials, Oak Ridge, TN (United States), 11-13 May 1993). Order Number DE93014013. Source: OSTI; NTIS; GPO Dep.

Objective of the Advanced Research and Technology Development materials program is to conduct R and D on materials for fossil energy applications (coal processing, coal liquefaction, gasification, heat engines and recovery, combustion systems, fuel cells). Research is aimed at better understanding of materials in fossil energy environments and development of new materials for improvement of plant operations and reliability. Abstracts are given of 37 papers on ceramics/composites, intermetallics (iron aluminides, etc.), and advanced austenitics. (DLC)

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Refer also to citation(s) 22873, 22916, 23040, 23042, 23180, 23267, 23327, 23371, 23377, 23378, 23379, 23381, 23504, 23505, 23578, 23580, 23629, 23655, 23839, 23841, 23842, 23971, 23972, 24084, 24107, 24109, 24139, 24162, 24164, 24262, 24263, 24496, 24501, 24516, 24981, 25210, 25211, 25336

23914 (ANL/MCT/CP–79046) **Corrosion performance of iron aluminides.** Natesan, K. Argonne National Lab., IL (United States). Mar 1993. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-9305135–1: 7. annual conference on fossil energy materials, Oak Ridge, TN (United States), 11-13 May 1993). Order Number DE93011768. Source: OSTI; NTIS; GPO Dep.

Iron aluminides are being developed for use as structural materials and/or cladding alloys in fossil energy systems. Extensive development has been in progress on Fe_3Al-based alloys to improve the engineering ductility of these alloys. This paper describes results from the ongoing program to evaluate the corrosion performance of these alloys. The experimental program at Argonne National Laboratory involvesthermogravimetric analyses of alloys exposed to environments that simulate coal gasification and fluidized-bed combustion. Experiments were conducted at 650–1000°C in simulated oxygen/sulfur gas mixtures. In addition, oxidation/sulfidation behavior of several alumina-forming Fe-Al and Fe-Cr-Ni-Al alloys was determined for comparison with the corrosion rates obtained on iron aluminides. Other aspects of the program are corrosion evaluation of the aluminides in the presence of HC1-containing gases and in the presence of slag from a slogging gasifier. Results are used to establish threshold Al levels in the alloys for development of protective alumina scales. Thermal cycling tests are used to examine the spalling resistance of the scales.

23915 (ANL/MSD/CP–79532) **On the hardening and softening of nanocrystalline materials.** Fougere, G.E. (Northwestern Univ., Evanston, IL (United States). Dept. of Materials Science and Engineering); Weertman, J.R.; Siegel, R.W. Argonne National Lab., IL (United States). Materials Science Div. Apr 1993. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38 ;FG02-86ER45229. (CONF-920947–5: Conference on nanostructured materials, Cancun (Mexico), 21-25 Sep 1992). Order Number DE93012901. Source: OSTI; NTIS; GPO Dep.

Nanocrystalline Pd and Cu samples have been thermally treated to determine whether the relation between hardness and grain size depend on the method used to vary the grain sizes. Previous reports indicate that hardening with decreasing grain size resulted from data obtained using individual samples, while softening with decreasing grain size resulted from data from a given sample that had been thermally treated. Hardening and softening regimes were evident for the nanocrystalline cu, and the hardness improvements over the original as-consolidated state were maintained throughout the thermal treatments. This review examines our hardness results for Cu and Pd and those for other nanocrystalline materials.

23916 (CONF-8905118–14) **Transport phenomena in welds with emphasis on free surface phenomena.** Szekely, J. Massachusetts Inst. of Tech.,-Cambridge, MA (United States). Dept. of Materials Science and Engineering. [1989]. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-87ER45289 ;FC05-85ER25000. From 2. international conference

on trends in welding research; Gatlinburg, TN (United States); 15-19 May 1989. Order Number DE93013436. Source: OSTI; NTIS; GPO Dep.

Purpose of this article is to address the free surface behavior of welding arc systems: The welding arc may be affected by weldpool shape, the interaction of plasma gas stream with weldpool may use surface instabilities, and collapse of deformed weldpool may produce weld defects. A brief review is given of the mathematical modeling of arc welding operations. While the discussion has focused on arc welding, the free surface problem may be of even greater importance in electron beam and laser welding. 39 refs., 13 figs.

23917 (CONF-9206173–11) **Understanding heat and fluid flow in linear GTA welds.** Zacharia, T.; David, S.A.; Vitek, J.M. Oak Ridge National Lab., TN (United States). [1992]. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 3. international conference on trends in welding research; Gatlinburg, TN (United States); 1-5 Jun 1992. Order Number DE93012958. Source: OSTI; NTIS; GPO Dep.

A transient heat flow and fluid flow model was used to predict the development of gas tungsten arc (GTA) weld pools in 1.5 mm thick AISI 304 SS. The welding parameters were chosen so as to correspond to an earlier experimental study which produced high-resolution surface temperature maps. The motivation of the present study was to verify the predictive capability of the computational model. Comparison of the numerical predictions and experimental observations indicate good agreement.

23918 (CONF-9209221–, pp. 197-221) **High flux positron beams for positron reemission microscopy and positron annihilation microprobe defect studies.** Canter, K.F. (Brandeis Univ., Waltham, MA (US)). Oak Ridge National Lab., TN (United States). Apr 1993. From Department of Energy (DOE) task force meeting workshop on the application of positron spectroscopy to materials sciences; Miranch Mirage, CA (United States); 9-11 Sep 1992. In *DOE workshop meeting on the application of positron spectroscopy to materials sciences: Proceedings.* 395p. Order Number DE93012784. Source: OSTI; NTIS.

Monovacancies play a fundamental role in the onset of damage in metals and in several other mechanical properties of materials. Of particular importance is the spatial distribution and subsequent motion of monovacancies, and the associated aggregation of the monovacancies into macroscopic defects. The recently developed positron reemission microscopy (PRM) has the potential for imaging the spatial distribution of monovacancies that are near the surface of negative positron work function metals. Such imaging is not possible with electron microscopes. A PRM image reveals subsurface and overlying structures that impede the reemission of positrons implanted into a sample. Since thermal and near-thermal positrons are readily trapped by monovacancies, a monovacancy at 1nm below the surface would produce a fuzzy spot with more than 50% contrast when viewed with a 1nm diffraction limited PRM at 50,000X magnification, for example. The contrast would decrease in a nearly linear fashion as the distance between the monovacancy and the surface would produce a fuzzy spot with more than 50% contrast when viewed with a 1nm diffraction limited PRM at 50,000X magnification, for example. The contrast would decrease in a nearly linear fashion as the distance between the monovacancy and the surface increases, with an estimated viewing depth ranging to roughly 10 nm below the surface. In order to achieve 1nm resolution, $10^{17}e^{+}/cm^{2}$ incident flux density on the sample is required, assuming a 10% reemission efficiency of the foil. This translates to $10^{10}e^{+}$ focussed into a 3 micron diameter spot, the smallest beam spot presently achievable. Taking into account the 90% loss in primary beam flux resulting from the brightness enhancement needed to obtain a 3 micron beam at 5 keV, one would thus need the equivalent of $10^{11}e^{+}$ emitted from a 10 mm diameter moderator with a transverse energy of 0.2eV or better for each PRM exposure.

23919 (CONF-921275–, pp. 49-52) **Discussions on a method to evaluate corrosion hazards in ocean vessel structures from formic acid, acetic acid, and propionic acid.** Kuraya, E. (Yokohama National University, Yokohama (Japan). Faculty of Engineering); Asakura, S.; Yano, C.; Asami, S. 2 Dec 1992. 160p. (In Japanese). From 25. safety engineering study meeting; Kitakyushu (Japan); 2-3 Dec 1992. In *Proceedings of the 25th Safety Engineering Study Meeting.* Order Number DE93793904. Source: OSTI; NTIS (US Sales Only).

Subsequent to the previous report which proposed a classifying chart to evaluate systematically corrosion hazards in chemicals corroding ocean vessel structural materials, the present paper determines corrosion hazards of formic acid, acetic acid, and propionic acid according to the chart, and discusses the reasonability of this evaluation method from results thereof. Test pieces (3×5×0.3 cm) were made from an SS 41 material, and the above three kinds of chemicals were used as the inspection chemical. A full immersion test was carried out on all of the test pieces immersed in the chemicals at 25°C for one to eight days to derive a corrosion loss (mm/y). A semi-immersion test was performed on the test pieces with half of each test piece surface immersed in the chemicals for seven days to derive the same parameter. The latter test is more stringent than the full immersion test because of additional effects of oxygen in atmosphere and chemical vapors. A flow chart determination according to the results of both tests classified all of the chemicals in the category No. 1 in the corrosion hazardous chemicals. The applicability of the classification chart was verified. 1 ref., 2 figs., 3 tabs.

23920 (CONF-921275–, pp. 53-56) **Discussions on a method to evaluate corrosion hazards in ocean vessel structures from sulfuric acid, nitric acid, and phosphoric acid.** Yano, C. (Shibaura Institute of Technology, Tokyo (Japan)); Asami, Y.; Kuraya, E.; Asakura, S. 2 Dec 1992. 160p. (In Japanese). From 25. safety engineering study meeting; Kitakyushu (Japan); 2-3 Dec 1992. In *Proceedings of the 25th Safety Engineering Study Meeting.* Order Number DE93793904. Source: OSTI; NTIS (US Sales Only).

Subsequent to the previous report which proposed a classifying chart to evaluate systematically corrosion hazards in chemicals corroding ocean vessel structural materials, the present paper determines corrosion hazards of sulfuric acid, nitric acid, and phosphoric acid according to the chart, and discusses the reasonability of this evaluation method from results thereof. Using test pieces made from an SS 41 material, a full immersion test, a semi-immersion test both using the above three kinds of chemicals, and a test with the chemicals added with water or sea water at 10% by weight assuming its mixing during ocean transportation were carried out. Further, considering a problem that may occur when corrosion rate increases with time, a YE test was also performed to measure polarization conductance (Y) and corrosion potential (E). When the results of these tests are classified according to the chart, phosphorous acid was determined as falling under the category No. 1 in the corrosion hazardous chemicals (with serious corrosion hazards as in undiluted solution), sulfuric acid as falling under the category No. 3 (seriously hazardous when mixed with water), and nitric acid as falling under the category No. 4 (seriously hazardous when mixed with sea water). The evaluation method was verified useful at the same time. 2 refs., 6 figs., 4 tabs.

23921 (CONF-921275–, pp. 79-80) **Surface modification on zirconium and its reactivity.** Shibasaki, A. (Kyushu Institute of Technology, Kitakyushu (Japan). Faculty of Engineering); Hara, Y.; Nakamura, H. 2 Dec 1992. 160p. (In Japanese). From 25. safety engineering study meeting; Kitakyushu (Japan); 2-3 Dec 1992. In *Proceedings of the 25th Safety Engineering Study Meeting.* Order Number DE93793904. Source: OSTI; NTIS (US Sales Only).

While zirconium (Zr) is used as an igniting agent for different kinds of explosive materials, it has a danger of igniting and exploding with a little friction or static electricity. Accordingly, a discussion was given on a surface preparation to suppress its shock sensitivity. The test materials were Zr and its equivalent mixture with an oxidizer (potassium perchlorate). Three types of test specimens were used for the surface preparation: Zr immersed in fluoro resin or epoxy resin solution to form films (specimen A); Zr oxidized in a 170°C oxygen flow to form oxide films (specimen B); and Zr stirred in hydrogen fluorides with various concentrations, filtered and dried (specimen C). The result of a friction and electrostatic sensitivity test revealed that a test specimen with 10% HF treated for 10 minutes among the test specimens C caused almost no ignition in

both sensitivities, and was most effective. A thermal reactivity test using a differential thermal analysis clarified that the peak positions of heat generation shifted to a higher temperature side in any of the test specimens and that the 3%-HF treated specimen in the Test specimens C showed no whatever reaction. 3 figs., 2 tabs.

23922 (CONF-921275–, pp. 139-142) **Studies on use conditions for steel containers for high-concentration alkaline aqueous solution.** Fukunaga, K. (Yokohama National University, Yokohama (Japan). Faculty of Engineering); Yoshikawa, M.; Miyata, Y.; Asakura, S. 2 Dec 1992. 160p. (In Japanese). From 25. safety engineering study meeting; Kitakyushu (Japan); 2-3 Dec 1992. In *Proceedings of the 25th Safety Engineering Study Meeting.* Order Number DE93793904. Source: OSTI; NTIS (US Sales Only).

Discussions were given on use conditions for steel containers for high-concentration alkaline aqueous solution. Test pieces were made from a general structural rolled steel material, and NaOH aqueous solution was used as a test sample solution. The steel continued actively dissolving under a temperature of 25°C and the atmosphere and with the solution concentration of 10.5 mol (boundary concentration) or higher. With the concentration lower than this, the steel turned passive. The corrosion rate (Ip) after having turned passive was discussed using the average corrosion rate (Ip) from weight losses, and the polarization conductance (Y_{corr}) The (Ip) and the Y_{corr} showed constant values regardless of the alkaline concentration, and the Ip increased logarithmically with rising temperature without depending on the concentration. The active dissolution rate showed a constant value at below the boundary concentration (60°C, 12.5 mol) without depending on the concentration, and increased logarithmically with rising temperature. Passivation of the steel at below the boundary concentration suppressed the corrosion rate to about 1/20 of that at active dissolution. The container use conditions call for passivating the steel at below the boundary concentration, setting 80°C as the upper use limit, and placing the steel in an inert atmosphere during active dissolution. 2 refs., 7 figs., 1 tab.

23923 (CONF-921275–, pp. 143-146) **Passivation of steel in high-speed neutral water. 2.** Yoshikawa, M. (Yokohama National University, Yokohama (Japan). Faculty of Engineering); Chimi, K.; Miyata, Y.; Asakura, S.; Haruki, Y.; Odagiri, A. 2 Dec 1992. 160p. (In Japanese). From 25. safety engineering study meeting; Kitakyushu (Japan); 2-3 Dec 1992. In *Proceedings of the 25th Safety Engineering Study Meeting.* Order Number DE93793904. Source: OSTI; NTIS (US Sales Only).

This paper reports the result of investigation on effects of flow velocity on corrosion of steel in neutral water in ranges from weak acidity to weak alkalinity. Corrosion of steel in tap water at low flow velocities from 0 m/s to 2 m/s is accelerated with increasing flow velocity, suppressed sharply at medium flow velocities from 2 m/s to 4 m/s, and remained constant at a high flow velocity of 4 m/s or higher. Average corrosion rate in weakly acidic buffer solution is higher than in other cases, and increased with increasing flow velocity. Corrosion in weakly alkaline buffer solution is somewhat accelerated in a high flow velocity region, but showed a constant average corrosion rate with small variation on the whole. Corrosion in neutral buffer solution is suppressed in the vicinity of zero flow velocity, but was accelerated when the flow velocity increased. From a test on corrosion in neutral phosphoric acid based buffer solution and tap water, and from anodic protection test, it was found possible that corrosion suppressing effect in a high flow velocity region in the tap water may emerge not simply from a passivation factor, but also from actions combined with other factors. Anodic protection on steel is effective in the buffer solutions, but not at all in the tap water. 1 ref., 5 figs., 3 tabs.

23924 (CONF-9306130–3) **On the gas dynamics of HVOF thermal sprays.** Hackett, C.M.; Settles, G.S.; Miller, J.D. Pennsylvania State Univ., University Park, PA (United States). Gas Dynamics Lab. [1993]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-92ER14302. From National thermal spray conference; Anaheim, CA (United States); 7-11 Jun 1993. Order Number DE93013803. Source: OSTI; NTIS; GPO Dep.

An experimental study has been performed on the gas dynamic aspects of the HVOF thermal spray process. A commercially-available HVOF gun (Hobart Tafa JP-5000) is used in this study. Optical diagnostic techniques including microsecond-exposure schlieren and shadowgraph imaging are applied to visualize the hot supersonic jet produced by this equipment without any particle injection. Rapid turbulent mixing of the jet with the surrounding atmosphere is observed, which is an issue of concern in coating quality because of the possibility of oxidation of the sprayed particles. This mixing appears principally to be a function of the density ratio between the hot jet and the cold atmosphere, rather than depending upon the combustion-chamber pressure or barrel length. The supersonic core of the HVOF jet dissipates rapidly due to the, mixing, so that the jet is no longer supersonic when it impinges upon the target surface being sprayed. Secondary issues also observed in this study include strong jet-noise radiation from the HVOF plume and the entrainment and induced bulk motion of the surrounding air. All these issues have a background in the field of gas dynamics which has not been previously applied to thermal spray technology.

23925 (CONF-930702–14) **Fatigue design curves for 6061-T6 aluminum.** Yahr, G.T. Oak Ridge National Lab., TN (United States). [1993]. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From Pressure vessel and piping conference; Denver, CO (United States); 25-29 Jul 1993. Order Number DE93011849. Source: OSTI; NTIS; GPO Dep.

A request has been made to the ASME Boiler and Pressure Vessel Committee that 6061-T6 aluminum be approved for use in the construction of Class 1 welded nuclear vessels so it can be used for the pressure vessel of the Advanced Neutron Source research reactor. Fatigue design curves with and without mean stress effects have been proposed. A knock-down factor of two is applied to the design curve for evaluation of welds. The basis of the curves is explained. The fatigue design curves are compared to fatigue data from base metal and weldments.

23926 (DOE/CE/15492–T4) **Production of reactive sintered nickel aluminide: Fifth quarterly technical progress report, February 22, 1993–May 22, 1993.** Cooper, R.M. Xform, Inc., Cohoes, NY (United States). 1993. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG01-91CE15492. Order Number DE93014434. Source: OSTI; NTIS; GPO Dep.

Effort over the past 3 months was directed at increasing manufacturing capacity (ball milling) and improving product quality. Orders for the powder have increased, mainly for plasma spray powders. NiAl is an excellent coat between a metal and a ceramic, and its use instead of cobalt should extending operating range for carbide tools. The feather phase in the sintered Ni_3Al was identified to be a Ni-rich phase nucleated on the grain boundaries with 10 wt % Al composition. The ductile to brittle temperature of powder extruded NiAl was found to be between 500 and 600 C, and shows a 50% elongation at 600 C.

23927 (DOE/ER/40643–2) **High field superconductor development and understanding: A. Establishing the limits of performance of niobium titanium; B. Establishing whether Chevrel Phase materials can become useful high field superconductors: Progress report, June 1, 1992–May 31, 1993.** Lee, P.J.; Jablonski, P.D.; Cooley, L.D.; Stejic, G.; Bonney, L.A.; Willis, T.C.; Larbalestier, D.C. Wisconsin Univ., Madison, WI (United States). Applied Superconductivity Center. 1993. 18p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-91ER40643. Order Number DE93013980. Source: OSTI; NTIS; INIS; GPO Dep.

The acquisition of a hydrostatic extrusion press now allows us to extrude composites under controlled conditions and enables us to fabricate new composite designs. We have successfully extruded a variety of composites including powder metallurgy APCs. Our conventional APC composite has been successfully brought to the completion of its fabrication. The results of the characterization of that composite have proven to be quite exciting. There is proof that the "ideal" microstructures that are hoped for in APC composites can be made. The flux pinning force of our APC composite is stronger than that for a conventional composite, despite having about half of the volume fraction of pins and a lower B_{c2} than occurs in a conventional composite. Additionally, the uniform nature of the microstructure makes our APC composite well-suited for

more fundamental studies of flux pinning. We have fabricated thin film "model" conductors in order to understand basic flux-pinning mechanisms and these films have yielded interesting data on the importance of film geometry. Further advances have been made in increasing the J_c of Chevrel Phase conductors and a clear path is now outlined for further improvement.

23928 (DOE/ER/45401–4) **Measurements of crystal growth kinetics at extreme deviations from equilibrium: Technical progress report, 1 September 1992–31 August 1993.** Aziz, M.J. Harvard Univ., Cambridge, MA (United States). Div. of Applied Sciences. 7 May 1993. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-89ER45401. Order Number DE93014526. Source: OSTI; NTIS; GPO Dep.

We have measured solute trapping of Sn in Al over a wide enough range of velocities to make a quantitative test of theory. The Continuous Growth Model of Aziz is the only one-parameter model that fits the data. We have also measured the diffusive speed - the growth rate at which interfacial partitioning is in mid-transition between equilibrium partitioning and complete solute trapping - for several solutes in A1. We have found an inverse correlation between the equilibrium partition coefficient and the diffusive speed. Taken together, these results give us heretofore unprecedented predictive capability in modeling rapid solidification processing. We have also examined theoretically short-range diffusion-limited growth, characteristic of incomplete solute trapping, and interface-limited growth, characteristic of complete solute trapping, in alloy solidification and have shown that the two regimes fall naturally out of a single unified theory of solidification.

23929 (DOE/ER/45403–4) **Atomic structures and compositions of internal interfaces: Progress report, September 1, 1992–August 31, 1993.** Seidman, D.N. (Northwestern Univ., Evanston, IL (United States). Dept. of Materials Science and Engineering); Merkle, K.L. Northwestern Univ., Evanston, IL (United States). Dept. of Materials Science and Engineering; Argonne National Lab., IL (United States). 10 May 1993. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-89ER45403. Order Number DE93014840. Source: OSTI; NTIS; GPO Dep.

This research program addresses fundamental questions concerning the relations between atomic structures and compositions of homophase and heterophase interfaces. Metal/ceramic heterophase interfaces are created via the process of internal oxidation of metallic alloys. The interfaces are studied via a combination of conventional transmission electron microscopy, high resolution electron microscopy, field-ion microscopy and atom probe microscopy. The latter technique is employed to chemically sequence the interfacial region, and to show that the terminating (222) plane of MgO and CdO consists solely of oxygen atoms forthe Cu/MgO (111) and Ag/CdO (111) heterophase interfaces, respectively; this is achieved with no deconvolution of the experimental data. The evolution of metal/ceramic heterophase interfaces is studied by following the process of internal oxidation on an atomic scale from its very earliest stages. It is demonstrated that during the early stages of internal oxidation that metal atom clusters as well as hypo and hyperstoichiometric metal-oxygen clusters are present. Solute-atom segregation to grain boundaries is studied in binary metal alloys employing the free energy simulations and the overlapping distribution Monte Carlo methodologies for dilute Pt(Au), Cu(Ni) and Pd(Ni) alloys for both twist and tilt boundaries.

23930 (DOE/ER/54134–2) **Repair welding of fusion reactor components: Second year technical report.** Chin, B.A. Auburn Univ., AL (United States). Dept. of Mechanical Engineering. 15 May 1993. 21p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG05-91ER54134. Order Number DE93015073. Source: OSTI; NTIS; INIS; GPO Dep.

Experiments have shown that irradiated Type 316 stainless steel is susceptible to heat-affected-zone (HAZ) cracking upon cooling when welded using the gas tungsten arc (GTA) process under lateral constraint. The cracking has been hypothesized to be caused by stress-assisted helium bubble growth and rupture at grain boundaries. This study utilized an experimental welding setup which enabled different compressive stresses to be applied to the plates during welding. Autogenous GTA welds were produced in Type 316 stainless steel doped with 256 appm helium. The application of a compressive stress, 55 MPa, during welding suppressed the previously observed catastrophic cracking. Detailed examinations conducted after welding showed a dramatic change in helium bubble morphology. Grain boundary bubble growth along directions parallel to the weld was suppressed. Results suggest that stress-modified welding techniques may be used to suppress or eliminate helium-induced cracking during joining of irradiated materials.

23931 (DOE/FTR–93010924) **Welding technologies as applied to nuclear manufacturing: Foreign trip report, September 25–October 8, 1992.** Roper, J.R. EG and G Rocky Flats, Inc., Golden, CO (United States). Rocky Flats Plant. 23 Oct 1992. 22p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC34-90DP62349. Order Number DE93010924. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This is the trip report of John R. Roper, who traveled to England September 25 through October 8, 1992. Dr. Roper attended the US/UK JOWOG 22-D Joining Technical Exchange meeting and gave a presentation on welding Finite Element Analysis and the Precision Joining Center at the Atomic Weapons Establishment in Aldermaston, United Kingdom. Dr. Roper also toured the Welding Institute in Abington, UK and discussed technology exchange of weld thermal and mechanical material responses.

23932 (DOE/FTR–93012551) **[Travel to Germany, France, and Sweden to obtain information about the underutilization of technologies by the US steel industry]: Foreign trip report, August 14–28, 1992.** DuBroff, W. USDOE Idaho Field Office, Idaho Falls, ID (United States). 28 Sep 1992. 13p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93012551. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The following were visited Aug. 14-28, 1992: MDH GMBH, Duesseldorf; PEAK Gmbh, Neviges; Boschgotthardschuette Gmbh, Siegen; University of Clausthal; IRSID (France); Verigen Deutscher Eisenhuettenleuter, Duesseldorf; Sandvik Steel AB; and MEFOS, Lulea, (Sweden). A lecture on Phase I of the Spray Forming Program was presented. There is a spray forming effort in Europe. The research effort in most processing areas exceeds that in USA by virtually all measures, reflecting industry's attitude that research is a necessity rather than an overhead. The laboratories are partially supported by the government. Implication is that U.S. industry will increasingly depend on foreign technology; this is further exacerbated by the fact that the heavy machinery industry in USA is nearly nonexistent. MDH is not impressed with direct steelmaking technology being investigated by AISI. The critical analysis that should have been commissioned is the relative merits of all of the competing processes (AISI, Corex, Dior, HiSmelt, etc.), because in the real world only one (or two at the most) will reach full-scale commercialization.

23933 (EGG-M–92696) **Performance aspects of de Laval spray-forming nozzles.** McHugh, K.M.; Key, J.F. EG and G Idaho, Inc., Idaho Falls, ID (United States). [1993]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-76ID01570. (CONF-9306165—1: Multiphase flow problems in manufacturing and productive technology, Bethesda, MD (United States), Jun 1993). Order Number DE93013671. Source: OSTI; NTIS; GPO Dep.

Spray forming is a multiphase fabrication technology in which a spray of finely atomized liquid droplets is directed onto a suitably shaped substrate or pattern to produce a coherent, near-net-shape deposit The technology can simplify materials processing where simultaneously improving product quality. Researchers at the Idaho National Engineering Laboratory (INEL) are developing spray-forming technology for producing near-net-shape solids and coatings of a variety of metals, polymers, and composite materials using de Laval nozzles. Here we briefly describe the flow field characterization and atomization behavior of liquid metals in linear de Laval nozzles, and illustrate their versatility by summarizing results from three spray-forming programs. In one program, low-carbon steel strip >0.75 mm was produced. In another program, polymer membranes ~ 5 μm thick were spray formed. Finally, recent results in spray forming molds, dies, and related tooling for rapid prototyping are described.

23934 (EGG-M–92715) **Use of de Laval nozzles in spray forming.** McHugh, K.M.; Key, J.F. EG and G Idaho, Inc., Idaho Falls, ID (United States). [1993]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-76ID01570. (CONF-9306130–2: National thermal spray conference, Anaheim, CA (United States), 7-11 Jun 1993). Order Number DE93010797. Source: OSTI; NTIS; GPO Dep.

Spray forming is a near-net-shape fabrication technology in which a spray of finely atomized liquid droplets is deposited onto a suitably-shaped substrate or pattern to produce a coherent solid. The technology offers unique opportunities for simplifying materials processing, oftentimes while substantially improving product quality. Spray forming is applicable to a wide range of metals and nonmetals, and offers property improvements resulting from rapid solidification (e.g. refined microstructures, extended solid solubilities, and reduced segregation). Economic benefits result from process simplification and the elimination of unit operations. Researchers at the Idaho National Engineering Laboratory (INEL) are developing spray-forming technology for producing near-net-shape solids and coatings of a variety of metals, polymers, and composite materials using de Laval nozzles. This paper briefly describes the atomization behavior of liquid metals in linear de Laval nozzles and illustrates the versatility of the process by summarizing results from two spray-forming programs. In one program, low-carbon steel strip > 0.75 mm thick was produced; in the other, polymer membranes ~5 μm thick were spray formed.

23935 (EGG-M–93104) **Bioextraction of cobalt from complex metal sulfides.** Thompson, D.L.; Noah, K.S.; Wichlacz, P.L.; Torma, A.E. EG and G Idaho, Inc., Idaho Falls, ID (United States). [1993]. 12p. Sponsored by USDOE, Washington, DC (United States); Department of the Interior, Washington, DC (United States). DOE Contract AC07-76ID01570. Contract J0134035. (CONF-930815–1: International biohydrometallurgy symposium, Jackson Hole, WY (United States), 22-25 Aug 1993). Order Number DE93013676. Source: OSTI; NTIS; GPO Dep.

The present study has investigated the bioleachability of naturally occurring cobaltite and synthetic cobalt sulfides using 29 pedigree and "wild type" strains of Thiobacillus ferrooxidans. On the basis of a screening test, five strains of bacteria were selected for assessing the effects of leach parameters (pH, ferrous and ferric sulfates, ammonium sulfate, bipotassium hydrogen phosphate, and substrate concentrations) on cobalt extraction from Blackbird Mine ore and concentrate. The mechanisms of cobalt extraction were explained in terms of direct and indirect modes of bacterial activity, and the chemistry involved in these processes was identified. Using various size fractions of a high-grade cobaltite, the kinetic parameters of cobalt extraction were derived for the effect of specific surface area to be V_m = 376 mg dm^{-3} h^{-1} and K 1.27 m^2 g^{-1}.

23936 (EGG-MS–10441) **Processing, properties, and wear resistance of aluminides.** Wright, R.N.; Rabin, B.H.; Wright, J.K. EG and G Idaho, Inc., Idaho Falls, ID (United States). Mar 1993. 42p. Sponsored by Department of the Interior, Washington, DC (United States). DOE Contract AC07-76ID01570. Contract JO134035. Order Number DE93012186. Source: OSTI; NTIS; GPO Dep.

Fully dense alloys based on Fe_3Al were produced by reaction synthesis from low cost elemental powders using hot pressing, hot isostatic pressing or Ceracon process. The reaction proceeds by outward spreading of a transient liquid phase from the initial aluminum particle site and precipitation of the compound phase from the liquid. Combustion synthesized material has a very fine grain size that is resistant to coarsening at high temperature because of a high density of fine oxides from the prior particle boundaries. The fine grain size results in approximately twice the yield strength in the reaction synthesized material compared to hot extruded prealloyed powder. Combustion synthesis has also been successfully applied to joining Fe_3Al and to forming coatings on carbon steel substrates. Combustion synthesis has been shown to be viable for fabricating trialuminides from elemental powder compacts. Al_3Ti, $Al_{73}Ti_{24}Cr_3$ and $Al_{67}Ti_{25}Cr_8$ were examined. Fully dense, homogeneous materials exhibiting an equiaxed grain structure were produced by conducting reaction and homogenization under pressure, or in a furnace at ambient pressure and subsequently densifying the porous preform by hot consolidation. The tetragonal DO_{22} structure was the primary reaction product for all compositions. Most of the Cr remained undissolved after reaction and a homogenization heat treatment at 1200C or above was used to put the Cr into solution and form the desired $L1_2$ phase.

23937 (ETDE/JP-mf–93794512, pp. 430-436) **Production technology under high-temperature and corrosive environment.: Corrosion-resistant materials and sealing technology.** Nakamura, S.; Maekado, S.; Tezuka, N. Japan National Oil Corp., Tokyo (Japan). 30 Oct 1992. 537p. (In Japanese). In *Record of TRC's activities in the fiscal year 1991.* Order Number DE93794512. Source: OSTI; NTIS (US Sales Only).

With an objective to deal with production of petroleum and gases at great depths under high temperatures and pressures, developmental research works are under progress on corrosion-resistant production members and sealing technology for tubing joints. The works are being moved forward under a nine-year plan that started in 1985. This paper is an annual report of the results obtained during the fiscal 1993. Subsequent to the results obtained by the previous year from tests on test pieces made from carbon steel base material, given different surface preparations, short pipe coating samples were fabricated on a trial basis using a plasma chemical vapor deposition (PCVD) process, and corrosion tests were carried out in 1993. The PCVD process achieved multiple-layer coating (on Cr plated base metal) with different substances including Al2O3/TiN/TiC. As a result of an autoclave corrosion test using 5% NaCl solution, a prospect was obtained on structuring films with high possibility of assuring corrosion resistance. On the other hand, it was impossible to eliminate pitting without using an inhibitor even under a mild condition. Joint samples were also fabricated and evaluated, and erosion tests were performed. 2 figs., 3 tabs.

23938 (ETDE-mf–93792750) **Corrosion by carbonisation gas. Final report.** Auer, W.; Wasner, W. Erlangen-Nuernberg Univ., Erlangen (Germany). Lehrstuhl fuer Werkstoffwissenschaften 4. Jan 1992. 47p. (In German). Contract FE-KKs-Project E 4.1/9. Order Number DE93792750. Source: OSTI; NTIS (US Sales Only).

The high temperature corrosion of iron based materials in H_2-Ar-H_2S-HCl gas mixtures was examined. Conditions with low oxygen activity and high sulphur and chlorine activities were simulated, such as occur in coal gasification or carbonisation of refuse. The effect of HCl on sulphidation of iron-based materials can be explained by the following effects: For cracked, poorly adhering layers, HCl can lead by transport processes via gaseous chlorine in hollow spaces of the layer to increased speed of sulphidation. For linear kinetics of sulphidation, which is caused by outer phase boundary reactions determining the speed, adsorbed HCl can block part of the surfaces and therefore reduce the speed of sulphidation. With a parabolic time law of sulphidation, covering part of the surface can lead to an initial or continuous reduction of the sulphur activity at the surface and therefore to the parabolic scale constant. Investigations on technical alloys show that HCl has the same effect on low alloy steels as on iron. For high alloy steels, there is only a slight effect from the HCl initially, and there is no change of the amount of metal removed in experimental times up to 1000 hours. Traces of chloride in the layers can, however, lead to hole corrosion on sulphides and metal in quiet conditions in damp air. (orig./MM).

23939 (GKSS–92/E/16) **Constitution and deformation of $Fe_3(AlSi)$-based intermetallic phases.** Bosse, H. (GKSS-Forschungszentrum Geesthacht GmbH (Germany). Inst. fuer Werkstofforschung). GKSS-Forschungszentrum Geesthacht GmbH, Geesthacht-Tesperhude (Germany); Technische Univ. Hamburg-Harburg, Hamburg (Germany). Arbeitsbereich Werkstoffphysik und -technologie. 1992. 291p. (In German). Order Number DE93792034. Source: OSTI; NTIS (US Sales Only).

The constitution of $Fe_3(AlSi)$-based alloys was examined by means of transmission electron microscopy and X-ray powder diffraction on quenched samples. Critical temperatures for DO_3-order as well as the ranges of the several miscibility gaps between the α solid solution and the ordered phase α' (B2 structure) and α'' (DO_3 structure) were determined in alloys with 80, 75 and 70 at%

iron. The critical temperatures were used to calculate the interaction and antiphase boundary energies within the framework of the Bragg-Williams approximation. The morphology of the two phase microstructures and the nucleation behaviour in the ordered alloys are discussed. Additionally the dislocation structures in $Fe_{70}Al_{30}$ single crystals deformed at different temperatures were investigated by electron microscopy and the results were compared to existing models to explain the temperature dependence of the yield strength. (orig.) With 130 figs., 17 tabs.

23940 (Juel–2681) **Deformation behaviour of thick walled tubes of X10NiCrAlTi 32 20 under cyclic thermomechanical loadings (ratcheting).** Schmidt-Plutka, A.; Breitbach, G.; Schubert, F.; Nickel, H. Forschungszentrum Juelich GmbH (Germany). Inst. fuer Reaktorwerkstoffe; Technische Hochschule Aachen (Germany). Oct 1992. 97p. (In German). Order Number DE93792709. Source: OSTI; NTIS (US Sales Only).

Dissertation submitted by A. Schmidt-Plutka.

In heat exchanger components which are exposed to temperatures of more than 500deg C, creep deformations must be taken into account. In the context of start up and shut down procedures or hot flow streaks secondary stresses are induced in these components. If additionally load controlled stresses (primary stresses) are present, e.g. in a tube under internal pressure, enhanced strain rates may occur (so called creep ratcheting). But also without any load controlled stresses, a progressive reduction in the length of the tube can occur. The strong temperature dependence of creep is responsible for this effect. Creep ratcheting was evaluated in axially unloaded and loaded thickwalled tubes of INCOLOY 800 under cyclic inductive heating conditions. The test of tubes under cylic heating conditions showed a progressive axial contraction. In the case of cyclic thermal stresses with a superimposed primary stress, the creep rate increased up to a factor between 2 and 9 compared to the creep rate for the same primary stress under constant temperature conditions. Under constant temperature conditions the effect of negative creep due to microstructural instabilities could be observed. For the calculation of the temperature distributions in thickwalled tubes under cyclic heating conditions a computer program has been used based on finite differences method. By using this calculated temperature fields the creep strain behaviour was investigated with the FE-code ABAQUS. Here without any primary stress the FE-calculations showed a progressive axial contraction in good consistency with the experiments. In the case of cyclic secondary stresses with additional primary stresses the relationship between the calculated ratcheting strain rates were slighlty underestimated. Nevertheless the theoretical analysis fairly confirmed the experimental results. (orig.).

23941 (KCP–613-4940) **Characterization of the personal computer based computed tomography system: Final report.** Ekis, J.W. Allied-Signal Aerospace Co., Kansas City, MO (United States). Kansas City Div. Feb 1993. 19p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00613. Order Number DE93008843. Source: OSTI; NTIS; GPO Dep.

The purpose of this project was to construct a personal computer based computed tomography (CT) system. The average industrial CT system ranges in price from $1,000,000 to $2,500,000. The entire PC based system at the Kansas City Division totaled around $300,000 to build. The system can detect flaws that are 0.010 inch in diameter. The resolution of the system is better than 0.020 inch. These measurements are valid for up to 3-inch-thick aluminum. In 1-inch- thick steel, the detectability is at least 0.020 inch and the resolution is better than 0.060 inch.

23942 (LA-UR–93-1670) **Micromechanical strength effects in shock compression of solids.** Johnson, J.N. Los Alamos National Lab., NM (United States). [1993]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9306167–4: Joint AIRAPT/APS meeting, Colorado Springs, CO (United States), 28 Jun - 3 jul 1993). Order Number DE93014425. Source: OSTI; NTIS; GPO Dep.

Time-resolved shock-wave measurements and post-shock recovery have long been used for inferring the underlaying micromechanics controlling high-rate deformation of solids; this requires considerable subjective interpretation. In spite of this, progress has been made in experimentation and theoretical interpretation of the shock-compression/release cycle and some of the results are reviewed here for weak shocks. This cycle involves the elements of the elastic precursor, plastic loading wave, pulse duration, release wave, and post-mortem examination. Those topics are examined, with emphasis on the second and fourth elements. Cu and Ta results show how shock data can be used to determine the transition from deformation mechanism of thermal activation to that of dislocation drag. Release-wave studies indicate that the leading observable release disturbance in fcc metals may not be propagating with the ideal longitudinal elastic-wave speed. 5 figs, 18 refs.

23943 (LBF-FB–196(1992)) **Improvement of corrosion fatigue behaviour of high-strength steel welds by means of optimized post weld treatments.** Mueller, F.; Sonsino, C.M.; Muesgen, B. Fraunhofer-Institut fuer Betriebsfestigkeit (LBF), Darmstadt (Germany). 1992. 69p. (In German). Order Number DE93792325. Source: OSTI; NTIS (US Sales Only).

In this research work the fatigue behaviour of welded V-shaped specimens made of the steels Fe E 355 KT and Fe E 690 V with two types of post weld treatment (TIG-dressing of the weld toe, shot peening of the weld toe) were examined. The specimens were submitted to random bending loading (variable amplitudes, spectrum loading with linear distribution of the amplitudes) under presence of a corrosive environment (artificial sea-water) unit final fracture occurred. When compared to the as-welded state, shot peening led to an increase of fatigue life by a factor of 3 to 10, depending on the material of the weld. TIG-dressing led to a factor of 13. The combination of both, TIG-dressing and subsequent shotpeening, led to an increase of fatigue life by a factor of 50 in the case of the Fe E 355 KT. On the other hand, if the influence of the corrosive environment on the TIG-dressed welds of Fe E 690 V was reduced by means of a cathodic protection, fatigue life could be improved by a factor of 100. The results of this research work show, that fatigue performance can be improved significantly, if the above mentioned post weld treatments are applied. It is now possible to apply the two steels with a higher efficiency, which will subsequently lead to a remarkable reduction of costs. (orig.) With 42 figs.

23944 (ORNL/FTR–4176) **[Development, processing, properties, and applications on advanced alloys, ceramics, polymers, and composites]: Foreign trip report, December 9–20, 1991.** George, E.P.; Bloom, E.E. Oak Ridge National Lab., TN (United States). 9 Jan 1992. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93011090. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The travelers attended and presented papers at the 2nd Japan International SAMPE Symposium including development, processing, properties, and applications on advanced alloys, ceramics, polymers, and composites. E.P. George visited several places studying intermetallic alloys. Much of the intermetallics research seems to be driven by MITI's national aerospace plant project for which TiAl and Nb_3Al are candidate materials. Work is also being done on Nb_3Al, Ni_3Al, FeAl, and NiTi. Processing research appears to be as important as research on deformation and fracture mechanisms, even at universities. The intermetallics field is growing, with Yamaguchi in charge of a new program recently started at universities, that will complement the MITI project. (DLC)

23945 (ORNL/FTR–4214) **Travel to Switzerland to attend the 1992 meeting of the International Cooperative Group on Irradiation-Assisted Stress Corrosion Cracking: Foreign trip report, March 9–14, 1993.** Bell, G.E.C. Oak Ridge National Lab., TN (United States). 27 Mar 1992. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93011107. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Presentations on "Spectral Effects on Radiation Damage Accumulation in Metals" and "Characterization of Radiation-Induced Segregation in the ICG-IASCC Round-Robin Materials Using Analytical Electron Microscopy and Scanning Auger Electron Microprobe Techniques" were given by the traveler at the 1992 meeting of the ICG-IASCC. During the two-and-one-half-day meeting, discussions of laboratory and fission reactor plant data, as well as

modelling of the mechanism(s) of IASCC, were inconclusive. The increasing data base suggests that there are at least two IASCC regimes. The first, at radiation doses less than 1 displacement per atom (dpa), is probably dominated by radiation-induced segregation (RIS) of solute atoms and an interaction of the material with the aqueous environment. The second is a higher dose regime, greater than 2 to 3 dpa, where the water environment may not be necessary to induce intergranular (IG) failure.

23946 (ORNL/FTR–4243) **[Travel to Japan for collaborative research on the high-temperature phase stability of austenitic stainless steels]: Foreign trip report, December 1, 1991–May 8, 1992.** Vitek, J.M. Oak Ridge National Lab., TN (United States). 18 May 1992. 24p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93011094. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The phase stability of austenitic stainless steels was examined during the five-month assignment to the Steel Research Laboratories of Nippon Steel Corporation. This laboratory has excellent facilities, many of which are unavailable at ORNL, and the studies complemented ongoing work in the Basic Energy Sciences (BES) Welding Science Program at ORNL. Thermodynamic calculations were made for a variety of alloy compositions in an attempt to better explain earlier experimental results obtained at ORNL under rapid solidification, laser welding conditions. In addition, further laser welding experiments were carried out to determine the effect of the base material structure on the solidification behavior of stainless steels. While on assignment at the Steel Research Laboratories, several side trips were made to other facilities to learn about ongoing activities in other groups. Much of the work in Japanese universities is published exclusively in Japanese literature, and the opportunity to learn firsthand about these activities was very productive. It was found that several research groups are involved in research directly related to that in ORNL's BES Welding Science Program, and it is hoped that the contacts that were made can be maintained to allow for better future collaboration with the various research groups.

23947 (ORNL/FTR–4283) **[High-temperature corrosion and protection of materials]: Foreign trip report, May 23–June 4, 1992.** Tortorelli, P.F. Oak Ridge National Lab., TN (United States). 19 Jun 1992. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93011072. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Two papers were presented by P.F. Tortorelli at the Third International Symposium on High-Temperature Corrosion and Protection of Materials in Les Embiez, France. Substantial interest was shown in current ORNL research on iron aluminides, Cr-Nb alloys, and mechanical properties of oxide scales. At least two other organizations are actively pursuing applications for iron aluminides. A good mix of basic and applied research papers contributed to the value of the symposium. Dr. Tortorelli also visited Harwell Laboratory and Cranfield Institute of Technology in the United Kingdom (U.K.). At Harwell, he discussed experimental procedures for very-high-temperature oxidation and innovative methods of corrosion analysis. During his visit to Cranfield, he was briefed on the modeling of erosion and corrosion processes and had discussions related to the mechanical properties of oxide scales. Efforts in corrosion, erosion, and coatings at Cranfield are extensive and impressive.

23948 (ORNL/TM–12094) **Detection of radiation-induced changes in electrochemical properties of austenitic stainless steels using miniaturized specimens and the single-loop electrochemical potentiokinetic reactivation method.** Inazumi, T.; Bell, G.E.C.; Kenik, E.A.; Kiuchi, K. Oak Ridge National Lab., TN (United States). Jan 1993. 64p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93012865. Source: OSTI; NTIS; INIS; GPO Dep.

Single-loop electrochemical potentiokinetic reactivation testing of miniaturized (TEM) specimens can provide reliable data comparable to data obtained with larger specimens. Significant changes in electrochemical properties (increased reactivation current and Flade potential) were detected for PCA and type 316 stainless steels irradiated at 200–420°C up to 7–9 dpa. Irradiations in the FFTF Materials Open Test Assembly and in the Oak Ridge Research Reactor are reported on. 45 figs., 5 tabs., 52 refs.

23949 (PNL-SA–21491) **Radiation hardening and radiation-induced chromium depletion effects on intergranular stress corrosion cracking of austenitic stainless steels.** Bruemmer, S.M.; Simonen, E.P. Pacific Northwest Lab., Richland, WA (United States). Mar 1993. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-930318–9: NACE annual corrosion conference and materials performance and corrosion show, New Orleans, LA (United States), 7-12 Mar 1993). Order Number DE93011602. Source: OSTI; NTIS; GPO Dep.

Available data on neutron-irradiated materials have been analyzed and correlations developed between fluence, yield strength, grain boundary chromium concentration and cracking susceptibility in high-temperature water environments. Large heat-to-heat differences in critical fluence (0.2 to 2.5 n/cm^2) for IGSCC are documented.In many cases, this variability is consistent with yield strength differences among irradiated materials. IGSCC correlated better to yield strength than to fluence for most heats suggesting a possible role of the radiation-induced hardening (and microstructure) on cracking. However, isolatedheats reveal a wide range of yield strengths from 450 to 800 MPa necessary to promote IGSCC which cannot be understood by strength effects alone. Grain boundary Cr depletion explain differences in IGSCC susceptibility for irradiated stainless steels. Cr contents versus SCC shows that all materials showing IG cracking have some grain boundary depletion ($\geq$2%). Grain boundary Cr concentrations for cracking (below ~16 wt %) are in good agreement with similar SCC tests on unirradiated 304 SS with controlled depletion profiles. Heats that prompt variability in the yield strength correlation, are accounted for bydifferences in their interfacial Cr contents. Certain stainless steels are more resistant to cracking even though they have significant radiation-induced Cr depletion. It is proposed that Cr depletion is required for IASCC, but observed susceptibility is modified by other microchemical and microstructural components.

23950 (UCRL–101096) **Evaluation of austenitic alloys 304L and 316L and alloy 825 under tuff-repository conditions.** Kass, J. Lawrence Livermore National Lab., CA (United States). May 1989. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-8802159–2: Workshop on waste container corrosion, Winnipeg (Canada), 9-10 Feb 1988). Order Number DE93013840. Source: OSTI; NTIS; INIS; GPO Dep.

Primary concerns over use of types 304L and 316L are for chloride- induced stress-corrosion cracking (SCC) and weld microstructure stability. Possibly alloy 825 will be a more suitable candidate. (DLC)

23951 (UCRL-ID–111598) **Waste disposal of HYLIFE II structure: Issues and assessment.** Lee, J.D. Lawrence Livermore National Lab., CA (United States). 17 Nov 1992. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE93011711. Source: OSTI; NTIS; INIS; GPO Dep.

Initial analysis has shown that by using 304 stainless steel (SS) a significant fraction (92 wt%) of the structural mass in the initial HYLIFE-II design could be disposed of by shallow burial. And if all the structural components are mixed together and treated as one entity, all of it could be disposed of by shallow burial. Two other types of SSs assessed, Mn-modified 316 and Prime Candidate Alloy (PCA), were found to require disposal by deep geologic burial of most of the structural mass. The presents of Nb and Mo in Mn-modified 316 and Prime Candidate Alloy (PCA), were found to dominate the generation of long term wastes produced and their presence should be avoided.

23952 (UCRL-JC–108750) **Micro-finish hard anodized coatings on aluminum.** Steffani, C. Lawrence Livermore National Lab., CA (United States). Mar 1992. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9206129–5: 1992 American Electroplaters and Surface Finishers Society conference (AESF SUR/FIN 92), Atlanta, GA (United States), 22-25 Jun 1992). Order Number DE93012480. Source: OSTI; NTIS; GPO Dep.

The production of thin hard anodized coatings on Single Point Diamond Turned (SPDT) 6061-T6 aluminum has been studied. The investigation centered on producing a surface finish of less than 10

microinch after anodizing. By starting with a 2 microinch (AA) surface finish and controlling time, temperature, current density and solution chemistry, coatings with surface finishes of 8 microinch and a thickness of .0003 inch, are obtained. Surface roughness from several anodizing solutions is compared. The operational life of a PTFE sliding seal against a coated cylinder bore is used as verification of finish quality.

23953 (UCRL-JC–109229) **Self-consistent electronic-structure calculations for interface geometries.** Sowa, E.C. (Lawrence Livermore National Lab., CA (United States)); Gonis, A.; MacLaren, J.M.; Zhang, X.G. Lawrence Livermore National Lab., CA (United States). Dec 1991. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-911202–88: Annual fall meeting of the Materials Research Society, Boston, MA (United States), 2-6 Dec 1991). Order Number DE93012496. Source: OSTI; NTIS; GPO Dep.

We describe a technique for computing self-consistent electronic structures and total energies of planar defects, such as interfaces, which are embedded in an otherwise perfect crystal. As in the Layer Korringa-Kohn-Rostol-er approach, the solid is treated as a set of coupled layers of atoms, using Bloch's theorem to take advantage of the two-dimensional periodicity of the individual layers. The layers are coupled using the techniques of the Real-Space Multiple-Scattering Theory, avoiding artificial slab or supercell boundary conditions. A total-energy calculation on a Cu crystal, which has been split apart at a (111) plane, is used to illustrate the method.

23954 (UCRL-JC–110996) **Machining aspects of nickel-phosphorus coatings.** Dini, J.W. Lawrence Livermore National Lab., CA (United States). Jul 1992. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9211117–7: Minerals, Metals, and Materials Society/American Society for Metals (TMS/ASM) materials week '92, Chicago, IL (United States), 2-5 Nov 1992). Order Number DE93013037. Source: OSTI; NTIS; GPO Dep.

Nickel-phosphorus coatings with greater than 10% phosphorus have been widely used for diamond turning applications such as fabrication of large optics and other high precision parts. This paper discusses the importance of phosphorus content of the alloy on wear of the diamond tool and provides some speculation on the role of phosphorus on machining characteristics.

23955 (UCRL-JC–111004) **Monte Carlo simulations of phase transformations in Fe-Cr alloys.** Reinhard, L.; Turchi, P.E.A. Lawrence Livermore National Lab., CA (United States). 1 Dec 1992. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-921101–117: 16. Material Research Society international symposium on the scientific basis for nuclear waste management fall meeting, Boston, MA (United States), 30 Nov - 5 dec 1992). Order Number DE93013847. Source: OSTI; NTIS; GPO Dep.

Phase stability properties of bcc based Fe-Cr alloys are examined in the framework of the-principles KKR-CPA-GPM formalism and Monte Carlo simulations. For Fe-rich alloys, ordered configurations are found stable with respect to the random state of the alloy, but unstable with respect to the pure Fe and Cr metals. Results are compared with the ones obtained by using energy parameters extracted from experimental diffuse scattering data.

23956 (UCRL-JC–111377) **Measurements of the thermal radiative properties of liquid uranium.** Havstad, M.A. (Lawrence Livermore National Lab., CA (United States)); McLean, W. II; Self, S.A. Lawrence Livermore National Lab., CA (United States). Jul 1992. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-920804–27: 28. national heat transfer conference, San Diego, CA (United States), 9-12 Aug 1992). Order Number DE93012595. Source: OSTI; NTIS; INIS; GPO Dep.

Measurements of the thermal radiative properties of liquid uranium have been made using an instrument with two optical systems, one for measuring the complex index of refraction by ellipsometry, the other for measuring the normal spectral emissivity by direct comparison to an integral blackbody cavity. The measurements cover the wavelength range 0.4 to 10 μm with sample temperatures between 940 and 1630 K. Two 5keV ion sputter guns and an Auger spectrometer produce and verify, in-situ, atomically pure sample surfaces. Good agreement between the two methods is observed for the normal spectral emissivity, which varies with wavelength in a manner typical of transition metals. The two components of the complex index of refraction, the index of refraction and the extinction coefficient, increase with wavelength, from ~3 at 0.4 μm to ~20 at 9.5 μm. Both components of polarized reflectivity are shown for visible to infrared wavelengths.

23957 (UCRL-JC–112060) **Statics and kinetics of phase transformations in bcc Fe-Cr.** Reinhard, L. Lawrence Livermore National Lab., CA (United States). 17 Nov 1992. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9206202–7: NATO advanced study institute on statics and dynamics of alloy phase transformations, Rhodes (Greece), 21 Jun - 3 jul 1992). Order Number DE93013839. Source: OSTI; NTIS; GPO Dep.

The Fe-Cr phase diagram exhibits a bcc solid solution (α-Fe-Cr) in a wide concentration range at high temperatures. This paper present applications of the Monte Carlo method in the framework of the three-dimensional Ising model to the problem of phase separation in α-Fe-Cr and compare the simulation results with experiment. (DCL)

23958 (UCRL-JC–112518) **Progress in zirconium resonance ionization spectroscopy.** Page, R.H.; Dropinski, S.C.; Worden, E.F. Jr.; Stockdale, J.A.D. Lawrence Livermore National Lab., CA (United States). 29 Dec 1992. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-930159–25: OE/LASE '93: International Society for Optical Engineering (SPIE) conference, Los Angeles, CA (United States), 16-23 Jan 1993). Order Number DE93011881. Source: OSTI; NTIS; GPO Dep.

We have examined the stepwise-resonant free-photon-ionization spectrum of neutral zirconium atoms using three separately-tunable pulsed visible dye lasers. The ground-level (first-step) transitions were chosen on the basis of demonstrated ^{91}Zr selectivity. Lifetimes of even-parity levels around 36000 cm^{-1}, measured with the delayed-photoionization technique, range from 10 to 100 ns. Direct ionization cross sections appear to be less than 10^{-17} cm^2; newly-detected autoionizing levels give peak ionization cross sections (inferred from saturation fluences) up to 10^{-15} cm^2. Portions of Rydberg series converging to the 315 and 763 cm^{-1} levels of Zr$^+$ were identified. "Clumps" of autoionizing levels are thought to be due to Rydberg-valence mixing.

23959 (WAPD-TM–1427) **Interaction of thermo-mechanical processing parameters and stress corrosion cracking for two heats of Ni-Cr-Fe Alloy 600.** Lynn, J.P.; Webb, G.L. Bettis Atomic Power Lab., West Mifflin, PA (United States). Feb 1984. 54p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC11-89PN38014. Order Number DE93012177. Source: OSTI; NTIS; GPO Dep.

The relationship between hot rolling parameters, annealing parameters, microstructures and stress corrosion cracking behavior of Ni-Cr-Fe Alloy 600 in deaerated primary plant grade water at 680°F was investigated. A high carbon (0.07%) and a medium carbon (0.04%) heat were hot rolled 20% or 80% starting at 3 different temperatures: below, near, and above the carbide solvus followed by annealing for 1 or 4 hours at a nominal temperature of 1600°F or 1900°F. Materials that are resistant to stress corrosion cracking were produced by hot rolling above the carbide solvus temperature followed by annealing at high temperatures (>1900°F). A combination of hot rolling below carbide solvus, large rolling reduction and a short annealing at a low temperature produced materials susceptible to stress corrosion cracking, especially for the high carbon heat. The resistant materials have by optical metallography as having carbide decorated grain boundaries, little intragranular carbide precipitation and good grain-boundary correlation between a nital and a phosphoric acid etch. The susceptible materials as lack grain boundary carbide precipitation, have heavy intragranular carbide precipitation and lack grain boundary correlation between a nital and a phosphoric acid etch.

23960 (WSRC-MS–93-037) **Acceptance criteria for corroded carbon steel piping containing weld defects.** Mertz, G.E.; Lam, P.S.; Awadalla, N.G. Westinghouse Savannah River Co., Aiken, SC (United States). [1993]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. (CONF-930702–18: Pressure vessel and piping conference, Denver, CO (United States), 25-29 Jul 1993). Order Number DE93011703. Source: OSTI; NTIS; INIS; GPO Dep.

Acceptance criteria for corroded low temperature, low pressure carbon steel piping containing weld defects is presented along with a typical application of these criteria. They are intended to preclude gross rupture or rapidly propagating failure due to uniform wall thinning, local wall thinning, pitting corrosion and weld defects. The minimum allowable uniform wall thickness is based on the code-of-record allowable stress and fracture criteria. Weld defects are postulated as potential sites for fracture initiation. CEGB/R6 failure assessment diagram is used as the fracture criteria to determine the minimum allowable wall thickness. Design of a large portion of the low temperature, low pressure piping is dominated by axial stresses. Existing local wall thinning acceptance criteria address high pressure piping where hoop stress dominates the design. The existing criteria is over conservative, in some cases, when used on low pressure piping. Local wall thinning criteria is developed to limit the axial stress on the locally thinned section, based on a reduced average thickness. Limits on pit density are also developed to provide acceptance criteria for pitted piping.

23961 (WSRC-MS–93-090) **Welding tritium aged stainless steel.** Kanne, W.R. Jr. Westinghouse Savannah River Co., Aiken, SC (United States). [1993]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. (CONF-9304103–5: Department of Energy (DOE) compatibility, aging and service life conference, Aiken, SC (United States), 20-22 Apr 1993). Order Number DE93011782. Source: OSTI; NTIS; INIS; GPO Dep.

Stainless steels exposed to tritium become unweldable by conventional methods due to He buildup within the metal matrix. With longer service lives expected for new weapon systems, and service life extensions of older systems, methods for welding/repair on tritium-exposed material will become important. Results are reported that indicate that both solid-state resistance welding and low-heat gas metal arc overlay welding are promising methods for repair or modification of tritium-aged stainless steel.

23962 (WSRC-TR–92-472) **A survey of techniques for corrosion monitoring.** Mickalonis, J.I. Westinghouse Savannah River Co., Aiken, SC (United States). Oct 1992. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE93012131. Source: OSTI; NTIS; INIS; GPO Dep.

Corrosion monitoring techniques have improved with advances in instrumentation technology and corrosion research. Older techniques, such as coupon immersion, generally provide historical information. The new electrochemical techniques, which have not been used widely at SRS, allow on-line monitoring and correlation with process changes. These techniques could improve the corrosion assessment of the waste tanks to be used for In-Tank Precipitation and Extended Sludge Processing. A task was initiated to place an electrochemical probe into tank 48 for testing the utility of this technique for waste tank applications.

23963 (Y–2457-3) **Y-12 Development Division technical progress report: Part 3, Metal processing period ending December 1, 1992.** Northcutt, W.G. Jr. (comp.). Oak Ridge Y-12 Plant, TN (United States). 26 Jan 1993. 20p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OS21400. Order Number DE93011836. Source: OSTI; NTIS; GPO Dep.

Type 1020 mild steel, IF-steel®(registered trademark of Armco Steel Corporation, Middletown, Ohio), and TI-Namel were exposed in molten lithium hydride (LiH) at 800C for cumulative times approaching 300 h. Mild steel decarburized at an extreme rate with the affected area exhibiting tremendous grain growth. In contrast, IF-steels® and TI-Namel do not experience decarburization or grain growth during identical exposures to LiH. All three steels experience net weight gains during extended exposure, and the data suggest that lithium penetration into the steel is the primary source of weight gain.

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Refer also to citation(s) 23431, 23450, 23859, 23860, 23918, 23924, 23937, 24087, 24278, 24468, 24496, 25004, 25209

23964 (ANL/OTM/CR–3) **Wear-mechanism modelling: Final report.** Ashby, M.F. (Cambridge Univ. (United Kingdom). Dept. of Engineering). Argonne National Lab., IL (United States); Cambridge Univ. (United Kingdom). Dept. of Engineering. Mar 1993. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. Order Number DE93012311. Source: OSTI; NTIS; GPO Dep.

Goals of the program are to calculate the surface temperatures in dry sliding, develop a soft wear tester for ceramics, survey the wear mechanisms in brittle solids, and couple the temperature calculations with models to give wear maps for brittle solids. (DLC)

23965 (CONF-9209221–, pp. 149-178) **Positron lifetime spectroscopy in oxides.** Pareja, R. (Universidad Carlos III de Madrid (ES)); Gonzalez, R. Oak Ridge National Lab., TN (United States). Apr 1993. From Department of Energy (DOE) task force meeting workshop on the application of positron spectroscopy to materials sciences; Miranch Mirage, CA (United States); 9-11 Sep 1992. In *DOE workshop meeting on the application of positron spectroscopy to materials sciences: Proceedings.* 395p. Order Number DE93012784. Source: OSTI; NTIS.

Experiments made in the past years have established that positron annihilation spectroscopy (PAS) can give information on the characterization and analysis of crystalline oxides to be used in energy-efficient devices. In these materials, a number of processes, ranging from the aggregation of vacancy-type defects in neutron irradiated crystals to the formation of bound states [e^+-H^-] when positrons are trapped by H^- ions, were studied by PAS. Work done in three systems is emphasized in this presentation: (1) Ceramic oxides, the importance in the development of fusion reactors; (2) ZnO crystals, the application in varistors and in electro-optics; (3) Cu_2O crystals, important constituent in the superconducting oxides. The materials of the first system are very good insulators while those of the second and third are semiconductors.

23966 (CONF-930513–2) **Fast Fourier Transform analysis of computer-acquired friction data.** Yust, C.S. Oak Ridge National Lab., TN (United States). [1993]. 20p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From Annual conference and exhibition of the Society of Tribologists and Lubrication Engineers; Calgary (Canada); 17-20 May 1993. Order Number DE93010337. Source: OSTI; NTIS; GPO Dep.

A commercial computer program for data acquisition and analysis has been used to facilitate the evaluation of the frequency content of friction force data obtained from a sliding wear test. The program uses a Fast Fourier Transform (FFT) algorithm to calculate the frequency spectrum of the friction force. The validity of the FFT program has been demonstrated by applying it to a recently published example that used a detailed mathematical treatment to remove an oscillatory component from friction data. When applied to friction force data from a pin-on-disk sliding wear test of NBD 200 silicon nitride sliding on NBD 100 silicon nitride, filtering of the dominant frequencies revealed by the FFT method reduces both the general dispersion of the friction values and almost completely eliminates localized signal perturbations. Successive filtering steps permit the association of particular frequencies with observed signal disturbances. Although the mean friction value in this example is not greatly altered by the frequency filtering, knowledge of the existing vibration frequency components in the tribosystem is important for a complete interpretation of wear mechanisms and for characterization of the machine/specimen interaction.

23967 (CONF-930783–1) **Microanalysis of directionally solidified cobalt oxide-zirconia eutectic.** Bentley, J. (Oak Ridge National Lab., TN (United States)); McKernan, S.; Carter, C.B.; Revcolevschi, A. Oak Ridge National Lab., TN (United States). [1993]. 2p. Sponsored by USDOE, Washington, DC (United States); National Science Foundation, Washington, DC (United

States). DOE Contract AC05-84OR21400 ;AC05-76OR00033. Grant: DMR-8901218. From 27. Microbeam Analysis Society meeting; Los Angeles, CA (United States); 11-16 Jul 1993. Order Number DE93013207. Source: OSTI; NTIS; GPO Dep.

Analytical electron microscopy (AEM) was performed with a AEM equipped with a field emission gun, an electron energy-loss spectrometer, and an energy-dispersive x-ray spectrometer. The microstructure consists of alternating lamellae of CoO and Ca- stabilized cubic-ZrO_2, each up to 1μm wide, and a thin (100- 200 nm) irregular layer of Co_3O_4 spinel extending into the CoO from the flat ZrO_2 interface. (DLC)

23968 (CONF-930822–5) **Flux-pinning related defect structures in melt-processed $YBa_2Cu_3O_{7-x}$.** Wang, Z.L.; Kontra, R.; Goyal, A.; Kroeger, D.M.; Allard, L.F. Oak Ridge National Lab., TN (United States). [1993]. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From Annual meeting of the Electron Microscopy Society of America; Cincinnati, OH (United States); 1-6 Aug 1993. Order Number DE93012759. Source: OSTI; NTIS; GPO Dep.

(HREM was used.) Stacking faults lying parallel to the (001) basal plane are observed near the Y211/Y123 (Y_2BaCu_5O/$YBa_2Cu_3O_{7-\delta}$) interfaces in Y123. These stacking faults are produced by either excess single Cu-O layers or double Cu-O and Y-O layers. Y enrichment and Ba depletion were observed near the Y211/Y123 interface; this is consistent with dissolution of trapped Y211. Such diffusion effects and stress due to lattice mismatch at Y211/Y123 interfaces may be the mechanisms for generating stacking faults around the Y211 particles in the Y123 matrix. A new type of defect with displacement vector 1/6[032] or 1/6[302] was also observed. (DLC)

23969 (DOE/ER/13560–7) **Investigation of PACVD protective coating processes using advanced diagnostics techniques: Performance report, 1 September 1992–30 April 1993.** Roman, W.C. United Technologies Research Center, East Hartford, CT (United States). 7 May 1993. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-86ER13560. Order Number DE93013978. Source: OSTI; NTIS; GPO Dep.

Objective is to understand the mechanisms governing nonequilibrium plasma atomistic or molecular deposition of hard face coatings. Laser diagnostic methods include coherent anti-Stokes Raman spectroscopy (CARS) and laser-induced fluorescence. TiB_2 and diamonds were used as the hard face coating materials. Diborane was used as precursor to TiB_2.

23970 (DOE/ER/13906–5) **[The molecular precursor strategy for the production of superconducting oxides]: Progress report.** Caulton, K.G. Indiana Univ., Bloomington, IN (United States). Dept. of Chemistry. Apr 1993. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-88ER13906. Order Number DE93015881. Source: OSTI; NTIS; GPO Dep.

$Cu(I)_2Zr_2(OR)_{10}$ (R=i-Pr) was prepared and reacted with O_2 and H_2O to form $Cu(II)_4Zr_4O_3(OR)_{18}$. This latter, layer-like compound show both ferro- and antiferro-magnetic coupling of adjacent d_9 Cu(II) centers through bridging O^{2-} and RO^- mediators, respectively. Thermolysis of $ClCuZr_2(OR)_9$ and $Cu_2Zr_2(OR)_{10}$ shows two sharp weight losses at <400 C to give Cu(0) and ZrO_2. Synthesis and characterization of $Na_2(THF)_4Cu[OCH(CF_3)_2]_4$ and $Na(THF)_2Cu[OC(CH_3)(CF_3)_2]_3$ are reported. Effect of chemical modification of a fluorinated alkoxide group on yttrium precursor identity was investigated.

23971 (DOE/ER/45147–8) **High resolution electron energy loss studies of surface vibrations: Progress report, November 1, 1990–May 1, 1993.** Kesmodel, L.L. Indiana Univ., Bloomington, IN (United States). May 1993. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-84ER45147. Order Number DE93014441. Source: OSTI; NTIS; GPO Dep.

New experimental investigations of surface vibrational properties of materials with high-resolution electron energy loss spectroscopy (EELS) axe reported. This document summarizes progress over the last three year project period on surface phonon measurements on copper (001); silver (111); ultrathin magnetic films; aluminum on silicon (111); and copper-oxide based superconductors.

23972 (DOE/ER/45228–65) **Surfaces and interfaces of ceramics and metals: [Final] report, July 1988–November 1992.** Arizona State Univ., Tempe, AZ (United States). 1992. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-86ER45228. Order Number DE93014959. Source: OSTI; NTIS; GPO Dep.

Structures of surfaces of several ceramic oxides were studied by use of reflection electron microscopy (REM) and associated techniques. High-temperature annealing in air or oxygen gives smooth, flat crystal faces in most cases, including the (111) MgO surface, previously thought to be facetted. Stability of the (111) MgO surface is shown to be due to a surface superlattice reconstruction. Surface superlattices, stable in air, have also been shown to exist on sapphire and rutile crystal faces. The segregation of Ca to the surface of MgO has been studied using reflection electron energy loss techniques. Initial studies of Cu-Au alloy crystal surfaces, necessarily carried out in ultra-high vacuum, have been made using RHEED and Auger electron spectroscopy. Clean alloy surfaces show surface reconstructions associated with the segregation of Au atoms at the surface. High-temperature annealing results in the segregation of sulfur to the surface and the formation of a variety of surface superlattice structures. Structures of solid-solid interfaces have been studied using a wide variety of electron-optical techniques including nanodiffraction and electron holography. In particular the interfaces in semiconductor multiple quantum well structures and also multilayer structures of Si and Co have been studied.

23973 (DOE/ER/45359–2) **The study of structure-processing-property relations in copper oxide based high $T_c$superconductors: Progress report, July 1992–June 1993.** Kingon, A.I. North Carolina State Univ., Raleigh, NC (United States). Dept. of Materials Science and Engineering. Jun 1993. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG05-88ER45359. Order Number DE93015066. Source: OSTI; NTIS; GPO Dep.

Objective is investigation of critical current limiting processes in bulk superconductors. Since the grain boundaries play a key role here, we focus on the electrical characterization of single grain boundaries. Electrical contact to thin polished sections is established with thermosonic wire bonding. Laser cutting is used to isolate a single grain boundary. Results on $YBa_2Cu_3O_x$ showed that two different types of grain boundaries are present. Most grain boundaries showed current voltage characteristics typical for flux pinning effect and no or little change in low magnetic fields. However, Josephson effect could also be found in some grain boundaries exhibiting a remarkable decrease of I_c in low magnetic fields. Both types could be found in the same sample. Additionally we are working on $Bi_2Sr_2CaCu_2O_x$ thick films grown on silver foil or MgO substrates. The films showed metallic behaviour and T_c=80K. Preliminary results showed that the grain boundaries are of the flux pinning type.

23974 (DOE/ER/45413–3) **Fundamental studies of new high-energy permanent magnet materials: Progress report, June 19, 1992–June 18, 1993.** Hadjipanayis, G.C. Delaware Univ., Newark, DE (United States). Dept. of Physics and Astronomy. [1993]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-90ER45413. Order Number DE93014707. Source: OSTI; NTIS; GPO Dep.

Rare-earth transition metal nitrides and carbides have been prepared by gas-solid reaction with N and HC gases. Neutron diffraction was used to study changes in structure which accompany the nitridation. In $NdFe_{10}Mo_2N_x$, nitrogen occupies the base center site (1/2, 1/2, 0) of the tetragonal unit cell with 84% occupancy. Two crystal structure types were found in $LaFe_{13-x}Si_x$; nitridation of the cubic phase expanded the unit cell by 6.2-10.8%, leading to increases in Curie temperature and spontaneous magnetization. The interstitial N atom from nitridation expanded the unit cell volume of $NdFe_{10}Mo_2$ by 3%; the Curie temperature reached 563 K. Magnetically hard $NdFeMoN_x$ with coercivity 8.8 kOe at RT and 33.7 kOe at 10 K were obtained by nitriding melt-spun ribbons.

23975 (IS-M–744) **Particle attraction effects on the centrifugal casting and extrusion of alumina.** Schilling, C.H. (Ames Lab., IA (United States)); Bergstroem, L.; Ker, H.L.; Aksay, I.A. Ames Lab., IA (United States). [1993]. 17p. Sponsored by USDOE,

Washington, DC (United States). DOE Contract W-7405-ENG-82. (CONF-930438–4: 95. annual meeting of the American Ceramic Society, Cincinnati, OH (United States), 18-22 Apr 1993). Order Number DE93011559. Source: OSTI; NTIS; INIS; GPO Dep.

Interparticle attraction forces were empirically related to the centrifugal casting and extrusion behavior of flocculated alumina suspensions. Attractive forces were altered by two approaches: Salt flocculation, which entails regulating the electrical double-layer thickness through electrolyte additions; and screening of van der Waals attraction by steric interactions of surface-adsorbed fatty acids. Specimens produced by both compressibility at a critical maximum density that increased with decreasing interparticle attraction. Gradients in packing density during centrifugal casting were alleviated using both methods as long as spatial variations of the effective stress were within the low-compressibility range. We hypothesized that the reduced interparticle attraction in both methods may also raise the threshold packing density at which ductile-to-brittle transitions occur during plastic shear. Specimens prepared with oleic acid adlayers were highly plastic and easily extrudable at solids contents of up to 59 vol%, although salt-flocculated samples at 55 vol% density extruded at creeping flow rates that were insensitive to the applied pressure. Results suggested that particle rearrangement during shear, is a rate-limiting process, with an average relaxation time that is lowered by reducing interparticle attraction.

23976 (LA–12520) **Prediction of alumina penetration.** Mandell, D.A. Los Alamos National Lab., NM (United States). Feb 1993. 30p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. Order Number DE93014017. Source: OSTI; NTIS; GPO Dep.

The MESA hydrocode was used to predict two-dimensional tests of L/D 10 and L/D 15 tungsten rods impacting AD 90 alumina with a steel backing. The residual penetration into the steel is the measured quantity in these experiments conducted at the Southwest Research Institute (SWR). The interface velocity as a function of time between an alumina target and a lithium fluoride window, impacted by an alumina disk at velocities between 544 m/s and 2329 m/s, was also predicted. These one-dimensional flyer plate experiments were conducted at Sandia National Laboratories using Coors AD 995 alumina. The material strength and fracture models are important in the prediction of ceramic experiments. The models used in these predictions are discussed. The penetrations in the two-dimensional tests were predicted to 11.4 percent or better. In five of the six experiments, the predicted penetration depth was deeper than the measured value. This trend is expected since the calculation is based on ideal conditions. The results show that good agreement between the 1-D flyer plate data and the MESA predictions exists at the lower impact velocities, but the maximum velocity is overpredicted as the flyer plate velocity increases. At a flyer plate velocity of 2329 m/s the code overpredicted the data by 12.3 percent.

23977 (ORNL/FTR–4568) **[A trip to Japan to present a lecture entitled "The DOE Ceramic Technology Project – 10 Years of Progress"]: Foreign trip report, March 12–20, 1993.** Johnson, D.R. Oak Ridge National Lab., TN (United States). 1 Apr 1993. 20p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93011585. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The traveler presented an invited lecture at the annual conference of the Japan fine Ceramics Program. Visits for the purpose of technical discussions were made to Keio University; Toyota Central Research and Development Laboratories, Inc.; Japan Fine Ceramics Center; Government Industrial Research Institute - Nagoya; Mechanical Engineering Laboratory; and the National Institute for Research in Inorganic Materials. A summary of these activities is included in this report.

23978 (SAND–93-0582C) **Amorphous sol-gel insulating films.** Brinker, C.J. (Sandia National Labs., Albuquerque, NM (United States)); Warren, W.L.; Logan, M.N.; Ashley, C.S. Sandia National Labs., Albuquerque, NM (United States). [1993]. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-921101–114: 16. Material Research Society international symposium on the scientific basis for nuclear waste management fall meeting, Boston, MA (United States), 30 Nov - 5 dec 1992). Order Number DE93012859. Source: OSTI; NTIS; GPO Dep.

The porosity of sol-gel thin films may be tailored for specific applications through control of the size and structure of inorganic polymers within the coating sol, the extent of polymer reaction and interpenetration during film formation, and the magnitude of the capillary pressure exerted during the final stage of drying. By maximizing the capillary pressure and avoiding excessive condensation, dense insulating films may be prepared as passivation layers on silicon substrates. Such films can exhibit excellent dielectric integrity, viz., low interface trap densities and insulating properties approaching those of thermally grown SiO_2. Alternatively, through exploitation of the scaling relationship of mass and density of fractal objects, silica films can be prepared that show a variation in porosity (7–29 %) and refractive index (1.42–1.31) desired for applications in sensors, membranes, and photonics.

23979 (UCRL-ID–113715) **Project proposal for partial computational physics support for Survivability of Coatings program.** Rhoades, C.E. Jr. Lawrence Livermore National Lab., CA (United States). Mar 1993. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE93013788. Source: OSTI; NTIS; GPO Dep.

Currently, the Survivability of Coatings (SOC) program uses the XRT computer code to calculate the effects of X-rays of various spectra on mirrors consisting of one or more optical coatings of specified thicknesses over various substrates. The following physical processes are modeled by XRT in one spatial dimension: (a) X-ray deposition and transport, (b) electron production, deposition and transport, (c) thermal conduction and transport, and (d) resulting static and dynamic stress and deformation. In general, the numerical techniques used in XRT are deterministic ones: X-ray transport is handled by multigroup discrete ordinates, electron transport is performed by the method of characteristics applied to a two term spherical harmonics expansion approximation (PI) of the Spencer-Lewis transport equations and thermal transport is done by a simple Richardson extrapolation of a backward Euler solution to the heat conduction equation. XRT has been used for both preshot and postshot analyses of samples for both aboveground tests (AGT) and underground tests (UGT). Agreement of analyses with experiment has been reasonably good. However, several samples predicted not to fail did appear to be damaged in a recent UGT. In addition, at least one sample predicted to fail did not. Preliminary analysis of the experimental samples on the recent AGT performed at Maxwell Laboratories in San Diego for the SOC program shows similar difficulties.

23980 (UCRL-JC–106137) **Effect of Y on cation and anion grain boundary diffusion in chromia.** King, W.E. (Lawrence Livermore National Lab., CA (United States)); Park, J.H. Lawrence Livermore National Lab., CA (United States). Jan 1991. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-890977–3: International congress on intergranular and interphase boundaries in materials, Paris (France), 4-8 Sep 1989). Order Number DE93013837. Source: OSTI; NTIS; GPO Dep.

Cation and anion diffusivities in the lattice and along grain boundaries have been measured on sintered polycrystals of Cr_2O_3 and Cr_2O_3-0.09 weight percent Y_2O_3 at 1100 C and at the oxygen partial pressure corresponding to that of the Cr/Cr_2O_3 equilibrium at that temperature. Results show the effect of Y is to enhance cation grain boundary diffusion. It was also observed that under the same conditions, anion diffusion is significantly faster than cation diffusion. Results are discussed in terms of their implications for the reactive element effect on high temperature oxidation of chromia forming alloys.

23981 (UCRL-JC–111025) **Formation of textured YBCO films by laser ablation.** Jankowski, A.F.; Olsen, B.L. Lawrence Livermore National Lab., CA (United States). Nov 1992. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-921101–118: 16. Material Research Society international symposium on the scientific basis for nuclear waste management fall meeting, Boston, MA (United

States), 30 Nov - 5 dec 1992). Order Number DE93013131. Source: OSTI; NTIS; GPO Dep.

Yttrium-Barium-Cooper-Oxide (YBCO) thin films are prepared using laser ablation. The <100> orientation of the 0.2–0.3 μm thin film is controlled using both substrate temperature and deposited buffer layers for epitaxial growth. Highly textured films are prepared with a c-axis preferred orientation using substrates of $SrTiO_3$ (100) and MgO (100) at a temperature of 780°C whereas a,b-axis films result if a 100nm buffer of Praseodymium-Barium-Copper-Oxide is first deposited at 700 C. The use of a 15nm buffer layer of $SrTiO_3$ on MgO (100) produces films with superconducting transitions equivalent to those YBCO films deposited directly on $SrTiO_3$ (100) substrates.

23982 (UCRL-JC–111437) **Absence of superconductivity in $(Pr_{1.5}Ce_{0.5})Sr_2Cu_2NbO_{10}$: A general correlation with magnetic ordering.** Radousky, H.B. (Lawrence Livermore National Lab., CA (United States)); Goodwin, T.J.; Shelton, R.N. Lawrence Livermore National Lab., CA (United States). Dec 1992. 6p. Sponsored by USDOE, Washington, DC (United States); National Science Foundation, Washington, DC (United States). DOE Contract W-7405-ENG-48. Grant DMR-90-21029. (CONF-930107–2: 2. Israeli international conference on high T_c superconductivity, Elat (Israel), 4-7 Jan 1993). Order Number DE93012579. Source: OSTI; NTIS; GPO Dep.

$(Pr_{1.5}Ce_{0.5})Sr_2Cu_2NbO_{10}$ is found to be an insulating analog to $(Nd_{1.5}Ce_{0.5})Sr_2Cu_2NbO_{10}$, $(Sm_{1.5}Ce_{0.5})Sr_2Cu_2NbO_{10}$ and $(Eu_{1.5}Ce_{0.5})Sr_2Cu_2NbO_{10}$ which have superconducting transition temperatures near 28 K. $(Pr_{1.5}Ce_{0.5})Sr_2Cu_2NbO_{10}$ is also observed to display two magnetic ordering transitions, near 15 K and 50 K, which are not observed for the Nd, Sm or Eu based materials. This compound is a new example of the absence of superconductivity in a $PrBa_2Cu_3O_7$ related structure which exhibits an unusually high magnetic ordering temperature relative to the other members of the rare earth series. An argument is made for a general correlation between the absence of superconductivity and the presence of magnetic ordering in these structures. The observation of this correlation in the $(R_{1.5}Ce_{0.5})Sr_2Cu_2NbO_{10}$ system is compared to similar observations in $RBa_2Cu_3O_7$ and $RBa_2Cu_2NbO_8$. The physical basis for the general nature of this correlation is discussed in terms of f electron hybridization and the unusual crystal field splitting observed for the Pr ion in the YBCO structure.

23983 (UCRL-JC–111458) **Absorption and damage thresholds of low defect density hafnia deposited with activated oxygen.** Chow, R.; Falabella, S.; Loomis, G.E.; Rainer, F.; Stolz, C.J.; Kozlowski, M.R. Lawrence Livermore National Lab., CA (United States). Oct 1992. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9210356–1: Laser-induced damage in optical materials, Boulder, CO (United States), 28-30 Oct 1992). Order Number DE93013853. Source: OSTI; NTIS; GPO Dep.

Motivation for this work included observations of a correlation between increasing laser damage thresholds and both decreasing nodular-defect density and absorption of coatings. We reduced the nodular-defect densities by a factor of over 4x in hafnia coatings deposited by reactive e-beam evaporation from a Hf target source. In order to increase the metal oxidation kinetics at the coated surface, Hf was e-beam deposited reactively with oxygen activated by a μ-wave discharge. The effect of using activated oxygen during the evaporation of a hafnia target source was also evaluated. A series of hafnia layers were made with various conditions; we alternated between two μ-wave configurations, hafnium and hafnia targets and two reactive oxygen pressures. Laser damage thresholds (1064 nm -10 ns pulses), absorption (at 511 nm) and nodular-defect densities from these coatings are reported. The damage threshold correlated inversely with the coating absorption.

23984 (UM-P–92/102) **Preparation and characterisation of the compound $Tl_{0.65}$ $Bi_{0.35}Ca_{0.8}$ $Sr_{1.7}$ Cu_2 O_y using oxalate co-precipitation and analytical CBED and an initial preparation of Bi_2 Ca_{n-1} Sr_2 Cu_n O_{4+2n} for n=5.** Goodman, P. (Melbourne Univ., Parkville, VIC (Australia). School of Physics); Nexhip, C.; O'Donnell, T.; Miller, P. Melbourne Univ., Parkville, VIC (Australia). School of Physics. [1992]. [10p.] Sponsored by Australian Research Council, Canberra, ACT (Australia). Grant no. A68930390. Order Number DE93625470. Source: OSTI; NTIS (US Sales Only); INIS.

A new superconducting compound of approximate formula $Tl_{0.65}Bi_{0.35}$ $Ca_{0.8}Sr_{1.7}Cu_2O_y$ has been prepared using oxalate co-precipitation of the Tl-free component followed by reaction with Tl_2O_3. This compound has orthorhombic symmetry (probable space group P2mm) and a Tc of 87K. A byproduct of this synthesis has been the synthesis of a new superconducting compound in the Bi-Ca-Sr-Cu-O series with a c-spacing of 55 Angstroms, and space group A2aa, which requires further evaluation. 4 refs., 4 figs.

3606 Other Materials

Refer also to citation(s) 22911, 22922, 23017, 23035, 23040, 23071, 23072, 23079, 23180, 23181, 23263, 23264, 23265, 23266, 23376, 23431, 23432, 23433, 23434, 23435, 23437, 23438, 23439, 23440, 23441, 23442, 23443, 23444, 23450, 23590, 23595, 23647, 23803, 23810, 23844, 23845, 23846, 23860, 23918, 23924, 23933, 23934, 23947, 23965, 23969, 23972, 24114, 24257, 24292, 24431, 24433, 24447, 24474, 24509, 24512, 24521, 24963, 25004, 25166, 25179, 25200, 25210, 25222, 25227

23985 (ANL/MCT/CP–78715) **Measurement of residual strain in composites by means of time-of- flight neutron diffraction.** Kupperman, D.S. (Argonne National Lab., IL (United States). Materials and Components Technology Div.); Majumdar, S.; Richardson, J.; Saigal, A. Argonne National Lab., IL (United States). Materials and Components Technology Div. [1993]. 16p. Sponsored by USDOE, Washington, DC (United States); National Aeronautics and Space Administration, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-9305188–1: 1993 annual meeting of the American Crystallographic Association (ACA), Albuquerque, NM (United States), 24-28 May 1993). Order Number DE93012939. Source: OSTI; NTIS; INIS; GPO Dep.

Neutron diffraction time-of-flight measurements using the Intense Pulsed Neutron Source at Argonne National Laboratory have been employed to study strain in various metal- and ceramic-matrix composites. For example, measurements carried out to 900 C on a composite composed of a titanium alloy matrix and silicon carbide fibers have been used to validate theoretical assumptions in the prediction of fabrication-induced residual stress. Sapphire reinforced nickel aluminide composites have also been studied. Studies of a high-temperature ceramic superconducting composite consisting of yttrium barium copper oxide and silver with various volume fractions of silver have also been carried out. The results of these studies have provided information on the effect of Ag content on interface bonding. In addition, ceramic-matrix composites with randomly dispersed ceramic whiskers with varying fiber content have been investigated.

23986 (ANL/MCT/CP–79029) **Development of nondestructive evaluation methods and prediction of effects of flaws on the fracture behavior of structural ceramics.** Ellingson, W.A.; Singh, J.P.; Holloway, D.L.; Dieckman, S.L.; Singh, D.; Sivers, E.A. Argonne National Lab., IL (United States). Materials and Components Technology Div. Mar 1993. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-9305135–3: 7. annual conference on fossil energy materials, Oak Ridge, TN (United States), 11-13 May 1993). Order Number DE93012942. Source: OSTI; NTIS; GPO Dep.

Work emphasized continuous-fiber ceramic matrix composites (CFCCs) with 2-D lay-ups composed of chemical-vapor-infiltrated (CVI) SiC/SiC materials, mostly made of Nicalon plain weave with 16 x 16 tows/in. One sample examined comprised a 3-D SiC/SiC braid made by Techniweave. Using a new 1024×1024×14 bit detector, images from 3-D X-ray CT data with pixel sizes of <140 μm and 2-D fast-Fourier transform (FFT) image processing, we have shown that fiber orientations can be measured to ±2-1/2°. 3-D FFT analysis was used to determine 3-D braid/weave fiber spacing. Multinuclear (^{1}H, ^{13}C, and ^{29}Si) NMR spectroscopy, is being studied. Surface chemistry of fibers and chemistry of interfacial regions in composites are being studied. We are also conducting initial studies to investigate the bulk composition of matrix materials (α, β, amorphous phase, silica, and oxynitride concentration) and surface chemistry of Si_3N_4 and SiC fibers. Fracture mechanics

work to correlate with NDE data focused on strength distribution of as-fabricated Nicalon fibers obtained from bundle tests. Strength distribution of fractured Nicalon fibers in composites was assessed from fracture mirror radii. SEM was used to determine distribution of fiber pullout length distribution for fibers in composites, for their strength distribution. From the strength distribution plots, scale parameters were determined to be 3.45 GPa for as-fabricated fibers and 1.31 GPa for fibers in processed composites. However, the Weibull moduli for the two distributions were similar. Reduction in strength of the fibers in processed composites is believed to be due to surface flaws and defects. Effects of fiber misorientation on mechanical properties of NDE-tested CVI continuous-fiber composites are currently being investigated. 8 figs, 11 refs.

23987 (BNL–70317) **[Travel to France for a plant inspection to establish the ability of Quartz et Silice to assess crystal growing capacity]: Foreign trip report, March 10–15, 1993.** Kettell, S.; Li, K.K. Brookhaven National Lab., Upton, NY (United States). 26 Mar 1993. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. Order Number DE93011429. Source: OSTI; NTIS (US Sales Only); GPO Dep.

An inspection of the plants was made with attention to facilities and capability of growing the pure CsI crystals required by the order. This included availability of manpower, raw materials, oven readiness, growth yield, process of cutting, polishing, wrapping, and measuring. An updated delivery schedule was agreed on which calls for completion of the first endcap (of E787 detector at Brookhaven AGS?) in June, and the second one in Oct. 1993.

23988 (BNL–70318) **[Travel to France for a plant inspection to establish the ability of Quartz et Silice to assess crystal growing capacity]: Foreign trip report, March 10–16, 1993.** Kettell, S. Brookhaven National Lab., Upton, NY (United States). 26 Mar 1993. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. Order Number DE93011428. Source: OSTI; NTIS (US Sales Only); GPO Dep.

A physical inspection of the CsI crystal growing capacity was made. The cutting and polishing facilities were inspected. The current inventory of crystals for our order was inspected. The facilities for measurement of the optical properties of the crystals was examined. We established that the shipment of the first completed ring of crystals and the presentation of a final schedule will be provided by Q+S by mid-April. The CsI crystals are for the two end caps of the E787 detector at the Brookhaven AGS.

23989 (CEA-CONF–11235) **Vacancies and negative ions in GaAs.** Corbel, C. Institut National des Sciences et Techniques Nucleaires (INSTN), Centre d'Etudes de Saclay, 91 - Gif-sur-Yvette (France). 1991. [6p.] (CONF-9108150–: 9. international conference on positron annihilation, Szombathely (Hungary), 26-31 Aug 1991). Order Number DE93625594. Source: OSTI; NTIS (US Sales Only); INIS.

We use positron lifetime studies performed in GaAs materials to show the defect properties which can be investigated by implanting positive positrons in semiconductors. The studies concern native and electron irradiation induced defects. These studies show that vacancy charge state and vacancy ionization levels can be determined from positron annihilation. They show also that positrons are trapped by negative ions and give information on their concentration.

23990 (CEA-CONF–11236) **Thermal and physicochemical properties important for the long term behavior of nuclear waste glasses.** Vernaz, E. (CEA Centre d'Etudes de la Vallee du Rhone, 30 - Marcoule (France). Dept. des Procedes de Retraitement); Matzke, H.J. CEA Centre d'Etudes de la Vallee du Rhone, 30 - Marcoule (France). Dept. des Procedes de Retraitement. 1992. [37p.] (CONF-920887–: 8. international symposium on thermodynamics of nuclear materials, Snowbird, UT (United States), 16-21 Aug 1992). Order Number DE93625592. Source: OSTI; NTIS (US Sales Only); INIS.

High level nuclear waste from reprocessing of spent nuclear fuel has to be solidified in a stable matrix for safe long-time storage. Vitrification in borosilicate glasses is the technique accepted worldwide. A number of different glasses was developed in different national programs. The criteria and the reasons for selecting the final compositions are briefly described. Emphasis is placed on the French product R7T7 and on thermal and physicochemical properties though glasses developed in other national projects (e.g. the German product GP 98/12 etc.) are also treated. The basic physical and mechanical properties and the chemical durability of the glass in contact with water or other aqueous solutions are described. The basic mechanisms of aqueous corrosion are discussed and the evolving modelling of the leaching process is dealt with, as well as effects of container material, backfill, etc. The thermal behavior has also been studied and extensive data exist on diffusion of glass constituents (Na) and of interesting elements of the waste such as the alkalis Rb and Cs or the actinides U and Pu, as well as on crystallization processes in the glass during storage at elevated temperatures. Emphasis is placed on the radiation stability of the glasses, based on extensive studies using short-lived actinides (e.g. Cm-244) or ion-implantation to produce the damage expected during long storage at an accelerated rate. The radiation stability is shown to be very good, if realistic damage conditions are used. The knowledge accumulated in the past years is used to evaluate and predict the long-term evolution of the glass under storage conditions.

23991 (CONF-9207203–, pp. 186-189) **Production technical development for mesocarbon microbeads.** Akinaga, H. (Osaka Gas Co. Ltd., Osak (Japan)); Yoshioka, M.; Tamamura, H.; Kitamoto, M. 22 Jul 1992. 320p. (In Japanese). From 1. meeting of The Japan Institute of Energy and the 70th Foundation anniversary meeting; Tokyo (Japan); 22-24 Jul 1992. In *Proceedings of the 1st Meeting of the Japan Institute of Energy and the 70th Foundation Anniversary Meeting.* Order Number DE93793523. Source: OSTI; NTIS (US Sales Only).

Optically anisotropic globules of 1μ m to 80μ m obtained by heating coal tar pitch at a temperature of about 400°C (mesocarbon microbeads: MCMB) have superior properties as a raw material for carbon materials, but render a large difficulty in industrial and continuous production techniques. This paper summarizes the CHERRY-T process as an established industrial process, and introduces characteristics and applications of the product MCMB. The process feeds coal tar into a reactor to heat it at a temperature of about 400°C under pressure to produce MCMB, separates the MCMB continuously using a high-temperature centrifugal separator, and refines the resultant solvent using tar medium oil and light oil. Reaction severity controls the MCMB grain size, and the solvent refining process controls volatiles. The MCMB is useful as a special carbon material for high-density carbon materials, a functional composite material for resins and rubbers, or a surface modifying material for column filling and adsorbing materials. 4 figs., 2 tabs.

23992 (CONF-9209221–, pp. 43-67) **Positron studies applied to microelectronics technology.** Rubloff, G.W. (IBM T.J. Watson Research Center, Yorktown Heights, NY (US)). Oak Ridge National Lab., TN (United States). Apr 1993. From Department of Energy (DOE) task force meeting workshop on the application of positron spectroscopy to materials sciences; Miranch Mirage, CA (United States); 9-11 Sep 1992. In *DOE workshop meeting on the application of positron spectroscopy to materials sciences: Proceedings.* 395p. Order Number DE93012784. Source: OSTI; NTIS.

Positron studies have already proven valuable in a variety of areas relevant to microelectronics, most notably the characterization of defects, interfaces, and materials in thin film and multilayer structures. Such studies have been directed largely toward the resolution of research issues in materials and processing science as well as solid state physics and chemistry. The purpose of this talk is to address potential applications of positron studies in microelectronics technology over a broader range, extending from research to technology development and manufacturing. Two key areas of opportunity for new characterization methods are: (1) enhanced ability to predict the performance of materials and devices, i.e., reliability science; and (2) more rapid learning about processes and their consequences for thin film structures during all phases of the technology development path. Reliability science is an extremely challenging aspect of microelectronics technology. Although achieving high manufacturing yield (% of chips which work) is important, it is at least as important that the product be reliable, i.e.

continue to function for years without failure. Extensive empirical work is normally done to assure reliability, primarily by acceleration testing experiments which operate the chips at elevated temperature, humidity, stress, or current/voltage to simulate longer-term behavior under less demanding, more representative conditions. Early detection of susceptibility to reliability failure modes would represent profound advantage, as well as a contribution toward the evolution of reliability science.

23993 (CONF-9209221–, pp. 131-148) **Defect characterization of overlayers and interfaces using variable energy positrons.** Lynn, K.G. (Brookhaven National Lab., Upton, NY (US)). Oak Ridge National Lab., TN (United States). Apr 1993. From Department of Energy (DOE) task force meeting workshop on the application of positron spectroscopy to materials sciences; Miranch Mirage, CA (United States); 9-11 Sep 1992. In *DOE workshop meeting on the application of positron spectroscopy to materials sciences: Proceedings.* 395p. Order Number DE93012784. Source: OSTI; NTIS.

The use of positron annihilation spectroscopy (PAS) to study overlayers, interfaces, and buried regions of semiconductors and metals, has seen rapid growth in the past few years. There are few other techniques that are sensitive to low concentrations of open-volume-type defects and are capable of nondestructive defect depth profiling. The characteristics of the annihilation gamma rays and the lifetime of the positron depend strongly on the local environment of the annihilation sites and can be used to quantitatively determine defect concentrations in a range inaccessible to conventional defect probes, yet important for the electrical performances of device structures. This talk will show how PAS can be used as a nondestructive probe to examine defects in technologically important systems. In silicon, the use of PAS to characterize the quality of overlayers as a function of different growth conditions, formation and annealing of defects after ion implantation, identification of defect complexes, and electric field distributions from charged defect centers, will be examined. The hydrogen activation energy for Si-SiO_2 interface trap centers, interface density variations, positron mobility in SiO_2, hole-trapping at Si-SiO_2 interface, radiation damage in Si-SiO_2 systems, and stress induced by thermal oxidation studies are summarized. The author also provides a brief summary of the use of PAS in other systems and some future directions. The need to complement these types of laboratory studies with the use of intense positron beams is addressed. In particular, the ability to perform 2D-ACAR on a small spot at various regions around the interface make it a very unique tool to determine not only the electronic structure of an interface but to identify the exact nature of the defects at the interface between two systems.

23994 (CONF-9209221–, pp. 123-130) **2D-ACAR and monoenergetic positron beams.** West, R.N. Oak Ridge National Lab., TN (United States). Apr 1993. From Department of Energy (DOE) task force meeting workshop on the application of positron spectroscopy to materials sciences; Miranch Mirage, CA (United States); 9-11 Sep 1992. In *DOE workshop meeting on the application of positron spectroscopy to materials sciences: Proceedings.* 395p. Order Number DE93012784. Source: OSTI; NTIS.

During the past 25 years the field of low energy positron physics has seen three major developments: (i) positron-defect studies; (ii) 2D-ACAR; and (iii) slow positron beams. These three developments have essentially changed the field from an esoteric activity practiced by a few university groups to one which is now embraced by major national and industrial laboratories. The recognition of positron trapping in open volume defects some 23 years ago broadened the scope of positron studies from essentially pure physics to a wide range of materials science. There is little doubt that the resulting stimulus and increased funding then provided was instrumental in the creation of 2D-ACAR and slow positron beams. The contribution of positrons to real world problems (i.e. recovery mechanisms in metals and alloys, degradation in reactor cladding materials etc.) was indeed repaid in the mid-seventies when technological advances made 2D-ACAR, at long last, a tenable proposition. The advance that represented, over the earlier practiced 1-D technique it now clear to us all.

23995 (CONF-9209221–, pp. 317-326) **Measurement of glass transitions and other properties of polymers by positron spectroscopy.** Jones, P.L. (Duke Univ., Durham, NC (US)). Oak Ridge National Lab., TN (United States). Apr 1993. From Department of Energy (DOE) task force meeting workshop on the application of positron spectroscopy to materials sciences; Miranch Mirage, CA (United States); 9-11 Sep 1992. In *DOE workshop meeting on the application of positron spectroscopy to materials sciences: Proceedings.* 395p. Order Number DE93012784. Source: OSTI; NTIS.

Increasingly, high tech polymers and composites are being substituted as structural materials for many engineering components traditionally fabricated from metallic alloys. Polymeric materials offer distinct advantages in many applications due to their high strength to weight ratios, as well as their superior insulating and damping properties. However, due to their molecular structure, polymeric materials exhibit thermo-mechanical behavior and environmental degradation mechanisms that are much different than those found in metallic alloys. As such, intelligent use of these materials in engineering applications requires a thorough understanding of their time dependent behavior. One method of evaluation that has proven very useful is positron annihilation lifetime spectroscopy (PALS). The positron lifetime spectra of amorphous and semicrystalline polymers typically can be deconvoluted into three and sometime four components. By formulating interpretations based on established free volume theory, PALS data can be used to predict changes in macroscopic behavior. Additionally, due to the molecular level sensitivity of this technique, PALS can be used to evaluate changes in physical properties before macroscopic property changes become evident. Degree of crystallinity, glass transition and sub-glass transition phenomena, hysteresis effects due to thermal cycling, physical aging and structural relaxation have all been characterized using PALS. Developing the methodology to quantitatively evaluate cavity size distributions and percent free volume from these parameters would provide the information needed to refine current understanding of the effects of thermo-mechanical treatment on molecular structure, and hence physical properties of engineering polymers.

23996 (CONF-9209221–, pp. 377-381) **[Polymer applications].** Sandreczki, T. (McDonnell-Douglas Corp., St. Louis, MO (US)). Oak Ridge National Lab., TN (United States). Apr 1993. From Department of Energy (DOE) task force meeting workshop on the application of positron spectroscopy to materials sciences; Miranch Mirage, CA (United States); 9-11 Sep 1992. In *DOE workshop meeting on the application of positron spectroscopy to materials sciences: Proceedings.* 395p. Order Number DE93012784. Source: OSTI; NTIS.

The author discusses several applications of positrons to the study of polymers. Free-volume effects are of particular interest to applied measurements. The questions include what is the functional free volume, exactly what does positron annihilation measure, what are the distribution functions of hole sizes as a function of temperature, pressure, and crosslinking, and what about physical aging problems. In an industrial setting, the author wants to see answers to these questions, not studies on the general problems. Particular engineering questions with regard to polymers which are of interest include: impact strength, and its aging; time changes in physical and chemical properties; presence of voids; delaminations; interfaces between fibers and the matrix; distribution of the plasticizer. The author wants specific answers to these questions, and in particular answers which can be given routinely with good response time. Other questions regarding conducting polymers are also listed.

23997 (CONF-921276–, pp. 215-218) **Preparation of large monolithic silica aerogel and measurement of its properties.** Tajiri, K. (Government Industrial Research Institute, Nagoya, Nagoya (Japan)); Igarashi, K.; Nishio, T.; Asahina, T. 3 Dec 1992. 305p. (In Japanese). From 1992 Japan Solar Energy Society, Japan Wind Energy Association joint converence; Osaka (Japan); 3-4 Dec 1992. In *1992 JSES (Japan Solar Energy Society)/JWEA (Japan Wind Energy Association) Joint Conference.* Order Number DE93793955. Source: OSTI; NTIS (US Sales Only).

Silica aerogel is a porous material expected to be developed for use as transparent heat insulators. Large cylindrical test specimens with a diameter of about 8 cm were fabricated on a trial basis for

discussion. TMOS was used as the raw material to fabricate test specimens with different densities. A conventional supercritical drying high-pressure vessel with a volume of 200 cm^3 as increased in size by adding 1000 cm^3 for the present experiment. Wet gels were dried in the drying vessel which was pressurized with nitrogen gas under predetermined temperature and pressure patterns. While the temperature distribution gradient has been found larger than the conventional cases, abrupt pressure variation at operating the valves was suppressed. Monolithic gels were obtained with a diameter of 8 cm and a thickness of up to 1.5 cm. The materials were removed from the vessel and heated in air to improve hydrophilicity, light permeation, and hardness. A suitable heat treatment temperature was found to be 500°C. For the light permeation, transparency as high as from 90% to 94% was obtained for the gel with a thickness of 1 cm. No aging effect of wet gel was observed on the light permeation. The monolithic gel was found different from the TEOS-based gel in the light permeation, which decreased with decreasing density. 11 figs.

23998 (CONF-921276–, pp. 219-222) **Preparation of electrochromic nickel oxide film by electrochemical deposition.** Miki, T. (Government Industrial Research Institute, Nagoya, Nagoya (Japan)); Yoshimura, K.; Tanemura, S. 3 Dec 1992. 305p. (In Japanese). From 1992 Japan Solar Energy Society, Japan Wind Energy Association joint converence; Osaka (Japan); 3-4 Dec 1992. In *1992 JSES (Japan Solar Energy Society)/JWEA (Japan Wind Energy Association) Joint Conference.* Order Number DE93793955. Source: OSTI; NTIS (US Sales Only).

An electrochromic nickel oxide film was formed on a glass substrate covered with indium tin oxide (ITO) using an electrolytic deposition process that uses nickel nitrate aqueous solution to evaluate the material properties. When a voltage of about ± 0.6V is applied across the ITO as the base and a platinum electrode using 1M KOH aqueous solution as an electrolyte, a typical electrochromism was exhibited, in which the light permeation changes reversibly. Current flowing in the film decreased and the voltamogram grew smaller as the number of cycles in the cyclic voltanmetry increased. No color extinguishing occurred after 20 cycles, and the film remained colored, and developed cracks and separation. The separation should have occurred resulting from weak adhesion of the film to the ITO which caused structural (volumetric) change in the film itself. Sintering the film improved the durability. When the sintering temperature exceeds 250°C, crystallization of the nickel oxide film develops more rapidly, the structural change progresses more slowly in the electrolyte solution, and the electrochromism emerging characteristic drops. 11 refs., 5 figs.

23999 (CONF-921276–, pp. 223-226) **Theoretical design of selective emissivity film. 2.: Improvement of radiative cooling power of silicon oxide film on Al substrate.** Tazawa, M. (Government Industrial Research Institute, Nagoya, Nagoya (Japan)); Tanemura, S. 3 Dec 1992. 305p. (In Japanese). From 1992 Japan Solar Energy Society, Japan Wind Energy Association joint converence; Osaka (Japan); 3-4 Dec 1992. In *1992 JSES (Japan Solar Energy Society)/JWEA (Japan Wind Energy Association) Joint Conference.* Order Number DE93793955. Source: OSTI; NTIS (US Sales Only).

With an objective to improve radiative cooling power of materials with selective emissivity using silicon oxide, a radiative cooling simulation was carried out on films with multiple components and layers. A material that utilizes the so-called atmospheric window with wavelengths from 8 μm to 13μm, and gives off thermal energy on the ground surface efficiently outside the atmosphere in the form of infrared radiation is called a selectively emissive material. The radiative cooling power may be improved by making radiative spectral of the material close to the ideal form by multiplying the components, and by reducing infrared absorption from the atmosphere in regions outside the atmospheric window by multiplying the layers. An SiO and Si compound film had the radiative cooling power increased by about 20% and the maximum ultimate temperature difference by 1°C to 2°C over a single SiO film. A dual layer film having an upper layer comprising the SiO and Si compound film and a lower layer comprising an SiO film showed the same trend, with an especially favorable result when the SiO ratio in the compound film is 0.4. A selectively emissive material using silicon oxide may be improved more effectively by multiplying the components than by multiplying the layers. 3 refs., 8 figs.

24000 (CONF-930561–4) **Thermographic properties of eight blue-emitting phosphors.** Cunningham, D.M. (Swarthmore Coll., PA (United States)); Allison, S.W.; Smith, D.B. Oak Ridge National Lab., TN (United States); Swarthmore Coll., PA (United States). [1993]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 39. international instrumentation symposium; Albuquerque, NM (United States); 2-6 May 1993. Order Number DE93010830. Source: OSTI; NTIS; GPO Dep.

We examined the effect of temperature on the light absorption and emission properties of eight phosphorescent compounds. These phosphors are commercially produced powders that emit mainly in the blue region when illuminated with ultraviolet light in the range 220 to 400 mn. Excitation and emission spectra measured over the range 20 to 350°C are examined for these phosphors. Data from the emission spectra indicate that there is a significant temperature dependence in this temperature range. In all eight phosphors, the maximum relative intensity decreased as the temperature increased. In some samples, the emission bandwidth and position also changed with temperature. Of these phosphors, $BaMg_2Al_{16}O_{27}$:Eu and $Ba_3(PO_4)_2$:Eu are candidates for studies at higher temperatures.

24001 (CONF-930822–4) **In-situ crystallization of silicate glass films deposited on α- Al_2O_3.** Mallamaci, M.P. (Minnesota Univ., Minneapolis, MN (United States). Dept. of Chemical Engineering and Materials Science); Carter, C.B.; Bentley, J. Oak Ridge National Lab., TN (United States). [1993]. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400 ;FG02-92ER45465 ;AC05-76OR00033. From Annual meeting of the Electron Microscopy Society of America; Cincinnati, OH (United States); 1-6 Aug 1993. Order Number DE93012969. Source: OSTI; NTIS; GPO Dep.

Ca aluminosilicate glass films were grown on single-crystal α-Al_2O_3 at <950 C by pulsed-laser deposition. The films were then heated in an electron microscope to determine the effect of α-Al_2O_3 crystallography on crystallization of Ca-aluminosilicate glasses. 4 figs, 5 refs. (DLC)

24002 (DOE/CE/23810–6) **Miscibility of lubricants with refrigerants, Phase 1: Final report, 6 February 1992–15 October 1992.** Pate, M.B. (Iowa State Univ. of Science and Technology, Ames, IA (United States). Dept. of Agricultural Engineering); Zoz, S.C.; Berkenbosch, L.J. Air-Conditioning and Refrigeration Technology Inst., Inc., Arlington, VA (United States); Iowa State Univ. of Science and Technology, Ames, IA (United States). Dept. of Agricultural Engineering. Oct 1992. 58p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-91CE23810. Order Number DE93014766. Source: OSTI; NTIS; GPO Dep.

Miscibility data have been obtained for a variety of non-CFC refrigerants and their potential lubricants. Ten different refrigerants and seven different lubricants were investigated. Experiments are being performed in two phases: Phase I, reported herein, focuses on performing screening tests for miscibility and Phase II consists of developing miscibility plots. The miscibility tests are being performed in a test facility consisting of a series of miniature test cells submerged in a constant temperature bath. The bath temperature can be precisely controlled over a temperature range of -50 C to 90C(-58 F to 194 F). The test cells are constructed to allow for complete visibility of lubricant-refrigerant mixtures under all test conditions.

24003 (DOE/CE/23810–8C) **Compatibility of refrigerants and lubricants with motor materials: Quarterly technical progress report, 1 October 1992–31 December 1992.** Doerr, R. (Trane Co., La Crosse, WI (United States)); Kujak, S.; Waite, T. Air-Conditioning and Refrigeration Technology Inst., Inc., Arlington, VA (United States); Trane Co., La Crosse, WI (United States). Jan 1993. 56p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-91CE23810. Order Number DE93014768. Source: OSTI; NTIS; GPO Dep.

Equipment manufacturers are challenged to replace CFC-based refrigerants and their lubricants with environmentally acceptable alternatives. Information on the compatibility of motor materials with these alternative refrigerants and lubricants is a basic requirement for reliable performance. This report presents compatibility data for 24 commercially used motor materials exposed to 17 refrigerant/lubricant combinations. This compatibility data will enable the phase out of CFC's to continue at its current fast pace and insure the continued reliable performance of refrigerant-based equipment.

24004 (DOE/CE/23810–11) **Materials Compatibility and Lubricants Research on CFC-refrigerant substitutes: Quarterly technical progress report, 1 January 1993–31 March 1993.** Godwin, D.A.; Hourahan, G.C.; Szymurski, S.R. Air-Conditioning and Refrigeration Technology Inst., Inc., Arlington, VA (United States). Apr 1993. 41p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-91CE23810. Order Number DE93014770. Source: OSTI; NTIS; GPO Dep.

The Materials Compatibility and Lubricants Research (MCLR) program supports critical research to accelerate the introduction of CFC-refrigerant substitutes. The MCLR program addresses refrigerant and lubricant properties and materials compatibility. The primary elements of the work include data collection and dissemination, materials compatibility testing, and methods development. The work is guided by an Advisory Committee consisting of technical experts from the refrigeration and air-conditioning industry and government agencies. Under the current MCLR program the Air-Conditioning and Refrigeration Technology Institute, Inc., (ARTI) is contracting and managing multiple research projects and a data collection and dissemination effort. Detailed results from these projects are reported in technical reports prepared by each researcher.

24005 (DOE/CE/23810–11A) **Solubility, viscosity and density of refrigerant/lubricant mixtures: Quarterly technical progress report, 1 January–31 March 1993.** Henderson, D.R. Spauschus Associates, Inc., Stockbridge, GA (United States); Air-Conditioning and Refrigeration Technology Inst., Inc., Arlington, VA (United States). Apr 1993. 31p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-91CE23810. Order Number DE93014771. Source: OSTI; NTIS; GPO Dep.

This report presents results for low refrigerant concentration (70, 80, 90 and 100 weight percent lubricant) mixtures of the following fluids: CFC-12/ISO 32 naphthenic mineral oil, HCFC-22/ISO 32 naphthenic mineral oil, CFC-12/ISO 100 naphthenic mineral oil, HFC-134a/ISO 22 pentaerythritol ester mixed acid, HFC-134a/ISO 32 pentaerythritol ester mixed acid #1, HFC-134a/ISO 68 pentaerythritol ester mixed acid, HFC-134a/ISO 100 pentaerythritol ester mixed acid, HFC-134a/ISO 32 pentaerythritol ester mixed acid #2, HCFC-123/ISO 32 naphthenic mineral oil, HCFC-123/ISO 100 naphthenic mineral oil, HCFC-123/150 SUS alkylbenzene, HCFC-123/300 SUS alkylbenzene. These data have been reduced to engineering form and are presented in the form of a Daniel Chart. Equations are given along with statistical measures of goodness of fit.

24006 (DOE/CE/23810–11B) **Measurement of viscosity, density and gas solubility of refrigerant blends: Quarterly progress report, 1 January 1993–31 March 1993.** Cavestri, R.C. (Air-Conditioning and Refrigeration Technology Inst., Inc., Arlington, VA (United States)); Munk, J. Imagination Resources, Inc., Dublin, OH (United States); Air-Conditioning and Refrigeration Technology Inst., Inc., Arlington, VA (United States). Apr 1993. 22p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-91CE23810. Order Number DE93014772. Source: OSTI; NTIS; GPO Dep.

Liquid/liquid miscibilities of four different 32 ISO VG polyolesters and one alkylbenzene at three concentrations were determined. Also a full vapor lubricant equilibrium (VLE) viscosity reduction of a 32 ISO VG mineral oil with HCFC-22 is complete. Partial viscosity reduction information by the fractionate components from R-502 in 32 ISO VG mineral oil is presented from 40C (104C) and 70C (158F) isotherms.

24007 (DOE/CE/23810–11C) **Accelerated screening methods for predicting lubricant performance in refrigerant compressors: Quarterly progress reports, 1 October 1992–31 December 1992 and 1 January 1993–31 March 1993.** Cusano, C. Illinois Univ., Urbana, IL (United States). Dept. of Mechanical and Industrial Engineering; Air-Conditioning and Refrigeration Technology Inst., Inc., Arlington, VA (United States). Mar 1993. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-91CE23810. Order Number DE93014773. Source: OSTI; NTIS; GPO Dep.

As the result of a thorough literature search and consultation with manufacturers of compressors, a specimen testing program is proposed to simulate specific contacts in components of compressors. Specimen testing will be conducted using a high pressure tribometer. Specific components to be simulated, with their approximate operating and environmental conditions, are identified. A list of references, related to compressors lubrication, friction and wear, is given in the Appendix.

24008 (DOE/CE/23810–11D) **ARTI Refrigerant Database.** Cain, J.M. (Calm (James M.), Great Falls, VA (United States)). Air-Conditioning and Refrigeration Technology Inst., Inc., Arlington, VA (United States); Calm (James M.), Great Falls, VA (United States). 30 Apr 1993. 121p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-91CE23810. Order Number DE93014774. Source: OSTI; NTIS; GPO Dep.

The Refrigerant Database consolidates and facilitates access to information to assist industry in developing equipment using alternative refrigerants. The underlying purpose is to accelerate phase out of chemical compounds of environmental concern. The database provides bibliographic citations and abstracts for publications that may be useful in research and design of air-conditioning and refrigeration equipment. The complete documents are not included. The database identifies sources of specific information on R-32, R-123, R-124, R-125, R-134, R-134a, R-141b, R-142b, R-143a, R-152a, R-245ca, R-290 (propane), R-717 (ammonia), ethers, and others as well as azeotropic and zeotropic blends of these fluids. It addresses lubricants including alkylbenzene, polyalkylene glycol, ester, and other synthetics as well as mineral oils. It also references documents addressing compatibility of refrigerants and lubricants with metals, plastics, elastomers, motor insulation, and other materials used in refrigerant circuits. Incomplete citations or abstracts are provided for some documents to accelerate availability of the information and will be completed or replaced in future updates.

24009 (DOE/ER/14062–3) **[Time-resolved optical studies of charge relaxation and charge transfer at electrode interfaces].** Pittsburgh Univ., PA (United States). [1992]. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-89ER14062. Order Number DE93013985. Source: OSTI; NTIS; GPO Dep.

Key components were identified in a quantitative model of carrier relaxation in semiconductor electrodes: nonlinear aspects of nonradiative and radiative recombination, effect of space charge field on carrier dynamics, self-absorption effects in direct gas semiconductors, and influence of surface state population kinetics on charge carrier recombination. For CdSe, the first three are operative (no direct proof of the last one). A realistic kinetic model for carrier recombination in the bulk of CdSe was used which includes important nonlinear effects, both radiative and nonradiative. The change in interfacial recombination velocity with the chemical nature of the sinterface was studied (n-CdSe/silane interfaces). Temperature effect (278 to 328 K) on fluorescence decay of n-CdSe in contact with 0.5 M KOH was found to be weak. An analytical solution was obtained for time-resolved fluoresence from electrodes under potential bias, and is being tested. Fluorescence work on a different material, CdS, indicate different recombination kinetics; this material was used to directly pump an optical transition of a surface state.

24010 (DOE/ER/45125–10) **Structures and shear response of lipid monolayers: Progress report, August 1, 1990–July 31, 1993.** Dutta, P.; Ketterson, J.B. Northwestern Univ., Evanston, IL (United States). Feb 1993. 19p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-84ER45125. Order Number DE93015076. Source: OSTI; NTIS; INIS; GPO Dep.

This report discusses our work during the last 3 years using x-ray diffraction and shear measurements to study lipid monolayers

(membranes). The report is divided into: (1) structure: phase diagram of saturated fatty acid Langmuir monolayers, effect of head group interactions, studies of transferred monolayers (LB films); (2) mechanical properties: fiber=optic capillary wave probe and centrosymmetric trough, mechanical behavior of heneicosanoic acid monolayer phases. (DLC)

24011 (DOE/ER/45205–8) **High temperature stability, interface bonding, and mechanical behavior in β-NiAl and Ni_3Al matrix composites with reinforcements modified by ion beam enhanced deposition: Progress summary report, June 1, 1993–May 31, 1994.** Grummon, D.S. Michigan State Univ., East Lansing, MI (United States). Dept. of Metallurgy, Mechanics and Material Science. 21 Jan 1993. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-85ER45205. Order Number DE93013977. Source: OSTI; NTIS; GPO Dep.

Diffusion-bonded NiAl-Al_2O_3 and Ni_3Al-Al_2O_3 couples were thermally fatigued at 900 C for 1500 and 3500 cycles. The fiber-matrix interface weakened after 3500 cycles for the Saphikon fibers, while the Altex, PRD-166, and FP fibers showed little, if any, degradation. Diffusion bonding of fibers to Nb matrix is being studied. Coating the fibers slightly increases the tensile strength and has a rule-of-mixtures effect on elastic modulus. Push-out tests on Sumitomo and FP fibers in Ni aluminide matrices were repeated. Al_2O_3 was evaporated directly from pure oxide rod onto acoustically levitated Si carbide particles, using a down-firing, rod-fed electron beam hearth; superior coatings were subsequently produced using concurrent irradiation with 200-eV argon ion-assist beam. The assist beam produced adherent films with reduced tensile stresses. In diffusion bonding in B-doped Ni_3Al matrices subjected to compressive bonding at 40 MPa at 1100 C for 1 hr, the diffusion barriers failed to prevent catastrophic particle- matrix reaction, probably because of inadequate film quality. AlN coatings are currently being experimented with, produced by both reactive evaporation and by N^+-ion enhanced deposition. A 3-kW rod-fed electron-beam-heated evaporation source has been brought into operation.

24012 (DOE/FTR–93012146) **[Cesium Iodide (CsI) crystal manufacture]: Foreign trip report, July 19–29, 1992.** Childress, S.R.; Ray, R.E. Jr. Fermi National Accelerator Lab., Batavia, IL (United States). 28 Aug 1992. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03000. Order Number DE93012146. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The CsI calorimeter which will be assembled by the KTeV collaboration is 2.0 meters by 2.0 meters square and consists of pure Cesium Iodide crystals. The crystals are 500 mm or 27 radiation lengths long and come in two transverse sizes; 25 mm square and 50 mm square. The crystals may be single units or they may be made from pairs of glued crystals. The mechanical tolerances and light output characteristics required of the crystals by KTeV are fairly stringent and are just at the edge of the state-of-the-art. We have visited the three companies who are bidding on the KTeV CsI order in order to evaluate their abilities to produce crystals sufficient for our purposes as well as to evaluate their production capabilities.

24013 (DOE/FTR–93013395) **Travel to Belgium for the 1992 EuChem Molten Salt Conference: Foreign trip report, March 23–April 3, 1992.** Murray, A.M. EG and G Rocky Flats, Inc., Golden, CO (United States). Rocky Flats Plant. 6 May 1992. 26p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC34-90DP62349. Order Number DE93013395. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document is mainly a report on the Euchem Molten Salt conference. (DLC)

24014 (DOE/FTR–93013657) **Travel to Japan to learn about III-V passivation and other III-V processing work, and to participate in the LAMP '92 conference: Foreign trip report, June 6–17, 1992.** Ashby, C.I. Sandia National Labs., Albuquerque, NM (United States). 13 Jul 1992. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. Order Number DE93013657. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Ashby visited researchers at the University of Tsukuba, NTT LSI Laboratories, and Fujitsu Laboratories to learn more about the mechanisms and processing techniques for electronic passivation of III-V compound semiconductor surfaces and about Fujitsu's application of a modified version of a photochemical process developed by Ashby and coworkers at Sandia. Ashby also presented an invited talk at the Second International Conference on Laser Advanced Materials Processing, which served to showcase Sandia National Laboratories as a premier laboratory in the area of laser processing.

24015 (FhG-IWM-Z–5/90) **Characterising the mechanical properties of carbon fiber reinforced high-output compound materials. Final report.** Thielicke, B.; Soltesz, U. Fraunhofer-Institut fuer Werkstoffmechanik, Freiburg im Breisgau (Germany); Bundesministerium fuer Forschung und Technologie, Bonn (Germany). Mar 1990. 56p. (In German). Contract BMFT 03M1017C. Order Number DE93795318. Source: OSTI; NTIS (US Sales Only).

In the context of the documented investigations, the newly developed compound materials were characterized with regard to their mechanical properties and the failure behaviour depending on the temperature, the ambient conditions and the type of load in different test devices. In the experiments and FE calculations, it was proved that the stresses in these anisotropic materials are very complex even in simple test processes, such as in a 3-point bending test or a 'single axis' tensile test and can lead to complicated stress distributions and superimpositions. The relationship of the strength values on the sample geometry measured in the bending and tensile tests is very frequently connected to a change of the failure process. Other effects are superimposed on the dependence on geometry, which result, from example, from the variation of material properties (compound partner, fibre content, type of reinforcement and fibre matrix adhesion) or stress and ambient conditions. (orig.).

24016 (IAEA-TECDOC–690) **The status of graphite development for gas cooled reactors: Proceedings of a specialists' meeting held in Tokai, Japan, 9-12 September 1991.** International Atomic Energy Agency, Vienna (Austria). Feb 1993. [311p.] (CONF-9109266–: International Atomic Energy Agency (IAEA) specialists meeting on status of graphite development for gas-cooled reactors, Tokai (Japan), 9-12 Sep 1991). Order Number DE93625195. Source: OSTI; NTIS (US Sales Only); INIS.

The meeting was convened by the IAEA on the recommendation of the International Working Group on Gas Cooled Reactors. It was attended by 61 participants from 6 countries. The meeting covered the following subjects: overview of national programs; design criteria, fracture mechanisms and component test; materials development and properties; non-destructive examination, inspection and surveillance. The participants presented 33 papers on behalf of their countries. A separate abstract was prepared for each of these papers. Refs, figs, tabs, photos and diagrams.

24017 (IAEA-TECDOC–690, pp. 49-58) **A microstructurally based fracture model for nuclear graphite.** Burchell, T.D. (Oak Ridge National Lab., TN (United States)). International Atomic Energy Agency, Vienna (Austria). Feb 1993. Contract DE-AC05-84OR21400. (CONF-9109266–: International Atomic Energy Agency (IAEA) specialists meeting on status of graphite development for gas-cooled reactors, Tokai (Japan), 9-12 Sep 1991). In *The status of graphite development for gas cooled reactors: Proceedings of a specialists' meeting held in Tokai, Japan, 9-12 September 1991.* [311p.] Order Number DE93625195. Source: OSTI; NTIS (US Sales Only); INIS.

This paper reports the physical basis of, and assumptions behind, a fracture model for nuclear graphites. Microstructurally related inputs, such as filler particle size, filler particle fracture toughness (K_{Ic}), density, pore size distribution, number of pores and specimen geometry (size and volume), are utilized in the model. The model has been applied to two graphites, Great Lake Carbon Corporation grade H-451 and Toyo Tanso grade IG-110. For each graphite, the predicted tensile failure probabilities are compared with experimental data generated using ASTM Standard C-749 tensile test specimens. The predicted failure probabilities are in close agreement with the experimental data, particularly in the case of H-451. The model is also shown to qualitatively predict the influence on the failure probabilities of changes in filler particle size, density, pore size, pore size distribution, number of pores and

specimen geometry (stressed volume). The good performance is attributed to the sound physical basis of the model, which recognizes the dominant role of porosity in controlling crack initiation and propagation during graphite fracture. (author). 8 refs, 12 figs, 1 tab.

24018 (IAEA-TECDOC–690, pp. 59-63) **Burst tests to measure the tangential strength of CFC tubes.** Roedig, M. (Forschungszentrum Juelich GmbH (Germany). Inst. fuer Reaktorwerkstoffe); Woschek, B.; Baur, W. International Atomic Energy Agency, Vienna (Austria). Feb 1993. (CONF-9109266–: International Atomic Energy Agency (IAEA) specialists meeting on status of graphite development for gas-cooled reactors, Tokai (Japan), 9-12 Sep 1991). In *The status of graphite development for gas cooled reactors: Proceedings of a specialists' meeting held in Tokai, Japan, 9-12 September 1991.* [311p.] Order Number DE93625195. Source: OSTI; NTIS (US Sales Only); INIS.

Carbon fiber reinforced composites (CFC) are considered as graphite/metal substitute material for certain structural components in modern HTR design. Internal pressure tests have been performed with tube segments made of CFC. The aim of the investigations was to value the failure of components under hoop stress and to compare the results to those obtained in relatively simple tests as split disk tests. The internal pressure was generated by gas and water. The main problem in the experiments was to prevent leakage at the end of the tubes without applying uncontrolled bending moments. Design methods supported by finite element calculations, helped to reduce these bending moments which could not be avoided totally however. Therefore the results of the burst tests must be considered as conservative. But compared to the split disk tests, the failure stress is twice as high as for the latter. Therefore it can be assumed, that for the given geometry, the split disk tests underestimate the tangential strength at least by a factor of two. (author). 9 figs.

24019 (IAEA-TECDOC–690, pp. 64-69) **Spatial variability in the tensile strength of an extruded nuclear-grade graphite.** Strizak, J.P. (Oak Ridge National Lab., TN (United States)). International Atomic Energy Agency, Vienna (Austria). Feb 1993. Contract DE-AC05-84OR21400. (CONF-9109266–: International Atomic Energy Agency (IAEA) specialists meeting on status of graphite development for gas-cooled reactors, Tokai (Japan), 9-12 Sep 1991). In *The status of graphite development for gas cooled reactors: Proceedings of a specialists' meeting held in Tokai, Japan, 9-12 September 1991.* [311p.] Order Number DE93625195. Source: OSTI; NTIS (US Sales Only); INIS.

This report will present the results of a study on spatial variations in the strength of nuclear-grade H-451 graphite. The tensile properties of H-451 were examined extensively in the past in order to characterize the variability of strength within billets, between billets and between lots. But the variability within a billet was, for the most part, studied only casually. The problem appeared to be the strong influence of a limited sampling plan in describing the mean strength and the variability. Therefore, an extensive, statistically sound sampling plan has been devised to fully characterize the spatial variability within a single billet. Test specimens were machined to conform to ASTM C749-87, "Standard Test Method for Tensile Stress-Strain of Carbon and Graphite". Test results have been obtained for four specimen sizes having gage diameters of 6.35, 9.53, 15.88, and 25.40 mm with respective gage-section volumes of 1407, 3163, 12,577, and 51,482 mm^3. A new fracture model developed by Burchell was applied to the data with encouraging results. This probabilistic failure criteria combines a microstructural basis with a fracture-mechanics approach to failure. (author). 8 refs, 20 figs, 1 tab.

24020 (IAEA-TECDOC–690, pp. 123-133) **Fabrication of HTGR core components by the method of volume gas-phase impregnation of porous media with pyrocarbon - main characteristics of the materials and products.** Zelenskij, V.F. (AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst.); Gurin, V.A.; Konotop, Yu.F.; Deryuga, Yu.A.; Kolosenko, V.V. International Atomic Energy Agency, Vienna (Austria). Feb 1993. (CONF-9109266–: International Atomic Energy Agency (IAEA) specialists meeting on status of graphite development for gas-cooled reactors, Tokai (Japan), 9-12 Sep 1991). In *The status of graphite development for gas cooled reactors: Proceedings of a specialists' meeting held in Tokai, Japan, 9-12 September 1991.* [311p.] Order Number DE93625195. Source: OSTI; NTIS (US Sales Only); INIS.

Considered are some special features of fabricating carbon-graphite materials and products by methods of volume gas-phase impregnation of porous substances with pyrocarbon. Main characteristics of the materials of this class are given. Results from reactor tests of the materials and products with a pyrocarbon binder as well as their possible applications are discussed. (author). 9 refs, 11 figs, 4 tabs.

24021 (IAEA-TECDOC–690, pp. 134-139) **Development of graphite for fuel element sleeves in advanced gas cooled reactors.** Burridge, D.P. (British Nuclear Fuels plc, Salwick (United Kingdom). Fuel Engineering Dept.); Naylor, J.E. International Atomic Energy Agency, Vienna (Austria). Feb 1993. (CONF-9109266–: International Atomic Energy Agency (IAEA) specialists meeting on status of graphite development for gas-cooled reactors, Tokai (Japan), 9-12 Sep 1991). In *The status of graphite development for gas cooled reactors: Proceedings of a specialists' meeting held in Tokai, Japan, 9-12 September 1991.* [311p.] Order Number DE93625195. Source: OSTI; NTIS (US Sales Only); INIS.

The graphite sleeve is the prime structural member of the advanced gas cooled reactor (AGR) fuel element in that each sleeve supports the pin cluster and all of the fuel assembly above it. It must have a low oxidation rate, a low permeability to maintain coolant flow in the channel, must be dimensionally stable within certain limits and have sufficient strength at the end of life to sustain refuelling operations. The paper describes a development programme covering design and improved graphite. Data is presented which is related to that anticipated in reactor behaviour of the material. It then proceeds to identify the quality assurance requirements of the sleeve material. Graphite sleeves produced from this programme of work are currently being irradiated as pilot loadings in UK reactors. (author). 5 refs, 4 figs, 4 tabs.

24022 (IAEA-TECDOC–690, pp. 140-146) **Mechanical properties and thermal shock resistances of recently developed high performance graphites.** Sato, S. (Ibaraki Univ., Hitachi (Japan). Faculty of Engineering); Kawamata, K.; Kurumada, A.; Chiba, A. International Atomic Energy Agency, Vienna (Austria). Feb 1993. (CONF-9109266–: International Atomic Energy Agency (IAEA) specialists meeting on status of graphite development for gas-cooled reactors, Tokai (Japan), 9-12 Sep 1991). In *The status of graphite development for gas cooled reactors: Proceedings of a specialists' meeting held in Tokai, Japan, 9-12 September 1991.* [311p.] Order Number DE93625195. Source: OSTI; NTIS (US Sales Only); INIS.

Recently, owing to the improvement of coke properties and the advances in arrangements and molding techniques, many graphite products possessing superior mechanical and physical properties have been developed. These graphite products are being used in metallurgy and new advanced technological fields, such as semiconductor industry, aerospace rockets and first wall of plasma-facing nuclear fusion devices. At present, the candidate for use as principal core construction material in JAERI's High Temperature Engineering Testing Reactor (HTTR) is generally regarded as the isostatically molded near isotropic graphite, IG-110. For use in HTTR, it is desirable that the graphite material possesses superior mechanical and physical properties, as well as the ability to minimize neutron irradiation damage during reactor operations. This report introduces the experimental results of recent studies on the mechanical properties especially, their strength against thermal stress, fracture toughness and, for part of the graphites, the effects of neutron irradiation and thermal shock resistance of several representative graphite brands. Comparisons are made with those of IG-110. From these experimental results, these several brands of graphites appear to have far superior properties compared to IG-110. Therefore it can be expected that, following future construction of the HTTR and during the stage of its operational tests, these high-performance graphites may have an opportunity to be utilized as the core graphite component to replace IG-110. (author). 16 refs, 1 fig., 2 tabs, 2 photos.

24023 (IAEA-TECDOC–690, pp. 177-182) **Effect of atmosphere on the bend strength of nuclear graphite.** Maruyama, T. (Power Reactor and Nuclear Fuel Development Corp., Oarai,

Ibaraki (Japan). Oarai Engineering Center). International Atomic Energy Agency, Vienna (Austria). Feb 1993. (CONF-9109266–: International Atomic Energy Agency (IAEA) specialists meeting on status of graphite development for gas-cooled reactors, Tokai (Japan), 9-12 Sep 1991). In *The status of graphite development for gas cooled reactors: Proceedings of a specialists' meeting held in Tokai, Japan, 9-12 September 1991.* [311p.] Order Number DE93625195. Source: OSTI; NTIS (US Sales Only); INIS.

Investigations were made of the effects of test environments on bend strength and fracture toughness of fine-grained isotropic graphites. Four-point bend tests were carried out in various atmospheres of air, helium and vacuum. When room temperature bend tests were carried out for specimens which had been outgassed in vacuum at high temperature, we obtained higher values than those measured in air by up to 45%. When measurements were made in helium atmosphere containing 1 to 3 ppm of water vapor, bend strength was higher by 20 to 30% than those measured in air. When water content in helium increased to about 20 ppm, the strength became the same with that measured in air. The high temperature bend strength of graphite specimens generally increased with increasing temperature up to 1200 deg. C if it had not been outgassed at 1200 deg. C. Whereas, the bend strength of specimens which had been outgassed at 1200 deg. C showed high room temperature strength followed by negative temperature dependence up to 900 deg. C, and then became temperature independent up to 1200 deg. C. The fracture toughness of fully outgassed specimens measured in vacuum had higher values by about 20% than that measured in air. (author). 11 refs, 5 figs, 4 tabs.

24024 (IAEA-TECDOC–690, pp. 149-158) **Behavior of gas desorption and gas permeability of carbon materials.** Okada, M. (Toyo Tanso Co., Ltd, Mitoyo, Kagawa (Japan)); Sogabe, T. International Atomic Energy Agency, Vienna (Austria). Feb 1993. (CONF-9109266–: International Atomic Energy Agency (IAEA) specialists meeting on status of graphite development for gas-cooled reactors, Tokai (Japan), 9-12 Sep 1991). In *The status of graphite development for gas cooled reactors: Proceedings of a specialists' meeting held in Tokai, Japan, 9-12 September 1991.* [311p.] Order Number DE93625195. Source: OSTI; NTIS (US Sales Only); INIS.

Carbon materials rather easily adsorb and desorb gases such as hydrocarbons, H_2, H_2O, CO and alcohols. It is very important to study the behaviour of gas desorption and gas permeability of carbon materials, especially when they are used in a vacuum vessel or a closed system. Gas desorption was studied by using Thermal Desorption Spectroscopy. Gas desorptions from isotropic graphites, Felt-C/C and B_4C graphite materials were measured. Thermal desorption spectra were obtained from IG-11, IG-110 and IG-110U graphites with a total ash content of 400 ppm, 10 ppm and 2 ppm, respectively. (author). 13 refs, 21 figs, 5 tabs.

24025 (IAEA-TECDOC–690, pp. 183-192) **Corrosion tests of matrix graphites.** Vavilin, A.I. (Scientific and Industrial Association 'Lutch', Podol'sk (Russian Federation)); Kulikov, E.T.; Mozzherin, S.I.; Chernikov, A.S. International Atomic Energy Agency, Vienna (Austria). Feb 1993. (CONF-9109266–: International Atomic Energy Agency (IAEA) specialists meeting on status of graphite development for gas-cooled reactors, Tokai (Japan), 9-12 Sep 1991). In *The status of graphite development for gas cooled reactors: Proceedings of a specialists' meeting held in Tokai, Japan, 9-12 September 1991.* [311p.] Order Number DE93625195. Source: OSTI; NTIS (US Sales Only); INIS.

The results of corrosion tests of matrix graphites based on calcinated (30PG graphite) and non-calcinated (MPG graphite) petroleum cokes in the temperature range 600-1200 deg. C and at the water vapour concentration in helium 0.01-1 vol.% are considered. Empirical expressions of the corrosion rate are obtained. Investigation results of matrix-graphite phase-components reactivity are considered. It is shown that the filler graphite 30PG has the minimum activity towards the water vapour. The influence of helium pressure at the constant partial pressure of water vapour, porous structure and of the impurities' content on the matrix graphite oxidation rate are considered. The results of corrosion tests of irradiated specimens of 30PG matrix graphite are given. (author). 3 refs, 7 figs, 4 tabs.

24026 (IAEA-TECDOC–690, pp. 233-241) **The effect of volume on the tensile strength of several nuclear-grade graphites.** Strizak, J.P. (Oak Ridge National Lab., TN (United States)). International Atomic Energy Agency, Vienna (Austria). Feb 1993. Contract DE-AC05-84OR21400. (CONF-9109266–: International Atomic Energy Agency (IAEA) specialists meeting on status of graphite development for gas-cooled reactors, Tokai (Japan), 9-12 Sep 1991). In *The status of graphite development for gas cooled reactors: Proceedings of a specialists' meeting held in Tokai, Japan, 9-12 September 1991.* [311p.] Order Number DE93625195. Source: OSTI; NTIS (US Sales Only); INIS.

This report presents the results of a study on the effects of stress volume on the tensile strength of two nuclear-grade graphites. The materials selected were H-451, an extruded near-isotropic graphite manufactured by Great Lakes Carbon Corporation, and IG-110, a fine-grained isotropic molded graphite manufactured by Toyo Tanso Company, Ltd. The tensile properties of H-451 were examined extensively in the past in order to characterize the variability of strength within billets, between billets, and between lots. But, the variability within a billet was, for the most part, studied only casually. The problem was the strong influence of a limited sampling plan in describing the mean strength and the variability. Therefore, an extensive, statistically sound sampling plan has been devised to fully characterize the spatial variability within a single billet. The effects of stress volume are being reexamined by comparing the strengths of four specimen sizes covering a broad range in stress volume. Test results for four specimen sizes having gage diameters of 6.35, 9.53, 15.88, and 25.40 mm are reported for H-451 graphite. Likewise, tensile test results for the isotropic, high strength IG-110 graphite are reported. 9 refs, 24 figs, 1 tab.

24027 (IAEA-TECDOC–690, pp. 241-248) **The effects of specimen geometry and size on the fracture toughness of nuclear graphites.** Romanoski, G.R. (Oak Ridge National Lab., TN (United States)); Burchell, T.D. International Atomic Energy Agency, Vienna (Austria). Feb 1993. (CONF-9109266–: International Atomic Energy Agency (IAEA) specialists meeting on status of graphite development for gas-cooled reactors, Tokai (Japan), 9-12 Sep 1991). In *The status of graphite development for gas cooled reactors: Proceedings of a specialists' meeting held in Tokai, Japan, 9-12 September 1991.* [311p.] Order Number DE93625195. Source: OSTI; NTIS (US Sales Only); INIS.

In a joint Oak Ridge National Laboratory (ORNL)/Japan Atomic Energy Research Institute (JAERI) study, various fracture toughness techniques were applied to Toyo Tanso grade IG-110 graphite to establish if specimen geometry influences on fracture toughness. The test geometries investigated were: compact tension (CT), disc compact tension (DCT), short rod (SR), chevron-notched short-rod (CNSR), cylindrical bend specimen (BS), and centrally slotted disc (CSD). Specimen geometries which allow slow crack propagation, such as the CNSR and CT, yielded higher fracture toughness values than those where fracture is very rapid, e.g., the CSD. In a further ORNL study, the CNSR specimen geometry was selected to investigate the effect of specimen size on fracture toughness. Three specimen sizes and three grades of graphite were examined: Great Lakes Carbon grade H-451, Stackpole grade 2020, and Toyo Tanso grade grade IG-110. Grade H-451 was the toughest graphite, while Stackpole 2020 was the least tough. Fracture toughness increased with increasing specimen size for all graphites tested. This result was attributed to rising R-curve behavior. (author). 13 refs, 8 figs, 3 tabs.

24028 (IAEA-TECDOC–690, pp. 248-255) **Cumulative fatigue damage on HTGR graphite.** Ishiyama, S. (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Dept. of High Temperature Engineering); Eto, M. International Atomic Energy Agency, Vienna (Austria). Feb 1993. (CONF-9109266–: International Atomic Energy Agency (IAEA) specialists meeting on status of graphite development for gas-cooled reactors, Tokai (Japan), 9-12 Sep 1991). In *The status of graphite development for gas cooled reactors: Proceedings of a specialists' meeting held in Tokai, Japan, 9-12 September 1991.* [311p.] Order Number DE93625195. Source: OSTI; NTIS (US Sales Only); INIS.

To investigate the effect of cyclic ratio and stress history on cumulative fatigue damage on fine-grained isotropic nuclear graphite,

two step fatigue tests were performed by the loading patterns in which peak load was changed from high level to low one (High-Low mode) and low level to high one (Low-High mode). From those results, the following conclusions were derived: (1) In High-Low mode, remarkable regeneration of stress history of first step loading to fatigue damage of second step were observed at first cyclic ratio of 0.1. (2) Cumulative fatigue damage of High-Low mode was well expressed as the following equations: $D_1+D_2=1$, $D_1=n_1/N_{f1}$, $D_2=n_2/(N_{f1}+N_{f2})A(n_1/N_{f1})^{(B)}$ where A and B are constants; (3) Cumulative fatigue damage of Low-High mode was well expressed as the following equations: $D_1+D_2=1$, $D_1=n_1/N_{f1}$, $D_2=n_2/(N_{f2}+N_{f1})C(n_2/N_{f2})^D$ where C and D are constants. (author). 7 refs, 9 figs, 2 tabs.

24029 (IAEA-TECDOC–690, pp. 256-261) **Fracture behavior of nuclear graphites under compressive impact loading.** Ugachi, H. (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Dept. of High Temperature Engineering); Ishihara, M.; Ishiyama, S.; Eto, M. International Atomic Energy Agency, Vienna (Austria). Feb 1993. (CONF-9109266–: International Atomic Energy Agency (IAEA) specialists meeting on status of graphite development for gas-cooled reactors, Tokai (Japan), 9-12 Sep 1991). In *The status of graphite development for gas cooled reactors: Proceedings of a specialists' meeting held in Tokai, Japan, 9-12 September 1991.* [311p.] Order Number DE93625195. Source: OSTI; NTIS (US Sales Only); INIS.

Compressive impact fracture behavior of two kinds of nuclear grade graphites, fine-grained isotropic IG-11 graphite and coarse-grained near-isotropic PGX graphite, have been investigated as a function of various strain rates up to more than 100 (1/s) at room temperature. Two types of cylindrical specimens, 12.5 mm in diameter with 25 mm length and 25 mm in diameter with 50 mm length, were employed to investigate the volume effect on compressive impact strength. Compressive fracture load, longitudinal and circumferential strains were measured in this test. The effect of strain rate up to 100(1/s) on compressive strength and deformation behavior of these graphites are discussed and the following conclusions were derived: (1) Compressive strength of graphites increased with increasing of strain rate up to 100(1/S) and is well expressed by the following equation: $\sigma_C=A\epsilon^B$ where σ_C, ϵ are compressive strength and strain rate and A and B are constants respectively. (2) Compressive strength decreased drastically with increasing of strain rate over 100(1/S). (3) Specimen volume effect on impact compressive strength and deformation behavior was not found. (author). 7 refs, 7 figs, 1 tab.

24030 (IAEA-TECDOC–690, pp. 299-303) **The correlation of hardness with Young's modulus and strengths of nuclear carbon materials.** Oku, T. (Ibaraki Univ., Hitachi, Ibaraki (Japan). Dept. of Mechanical Engineering); Ohta, S.; Eto, M. International Atomic Energy Agency, Vienna (Austria). Feb 1993. (CONF-9109266–: International Atomic Energy Agency (IAEA) specialists meeting on status of graphite development for gas-cooled reactors, Tokai (Japan), 9-12 Sep 1991). In *The status of graphite development for gas cooled reactors: Proceedings of a specialists' meeting held in Tokai, Japan, 9-12 September 1991.* [311p.] Order Number DE93625195. Source: OSTI; NTIS (US Sales Only); INIS.

Since mechanical properties of carbon materials are, in general, necessary and important for the structural design of the components of HTGRs, much data on each candidate material has been obtained so far. A correlation between Vickers hardness and strengths of different grades of graphite has been examined and as a result a good correlation with compressive strength was found. According to recent results of the instrumented hardness test that enables to measure the load and the depth continuously, some parameters obtained from the load versus depth relation had good correlations with Young's modulus and strengths. Also correlations of the harness value with Young's modulus, bending strength and compressive strength were examined on the different kinds of carbon materials including the nuclear grades of graphite. As a result, the hardness values defined in the instrumented microhardness test, as well as the normal Vickers hardness value, had comparatively good correlations with Young's modulus, bending strength and compressive strength. (author). 4 refs, 7 figs, 1 tab.

24031 (IAEA-TECDOC–690, pp. 219-225) **Capsule design, fabrication and irradiation for tensile creep test on HTGR graphites at 1200 deg. C in the JMTR.** Saito, T. (Japan Atomic Energy Research Inst., Oarai, Ibaraki (Japan). Oarai Research Establishment); Kikuchi, T.; Arai, T.; Ugachi, H. International Atomic Energy Agency, Vienna (Austria). Feb 1993. (CONF-9109266–: International Atomic Energy Agency (IAEA) specialists meeting on status of graphite development for gas-cooled reactors, Tokai (Japan), 9-12 Sep 1991). In *The status of graphite development for gas cooled reactors: Proceedings of a specialists' meeting held in Tokai, Japan, 9-12 September 1991.* [311p.] Order Number DE93625195. Source: OSTI; NTIS (US Sales Only); INIS.

An irradiation creep test under uniaxial tension in JMTR has been performed by JAERI as one of the collaborative efforts on HTGR graphite development and testing with USDOE. The purpose of the test is to determine secondary creep coefficients at 1200 deg. C of isotropic IG-110 graphite and near-isotropic H-451 graphite. The irradiation capsule has withstood so far c.a. 1600 EFPH irradiation in JMTR. The paper describes the outline of the design, fabrication and operational progress of the capsule designated as Capsule 89M-6A. Thermal and structural designs were devised to achieve the good thermal insulation and the mechanical integrity of key components inside the capsule. Seven dogbone type tensile specimens were encapsulated together with other unstressed control specimens. The specimen temperature control system and load control system are similar to those utilized in the previous creep tests. In the course of three irradiation cycles in JMTR, the graphite specimens have been subjected to nearly constant temperatures and the specified tensile load. The capsule will be unloaded after another irradiation cycle. (author). 9 refs, 9 figs, 1 tab.

24032 (INIS-JP–007, pp. 620-624) **Ion beam techniques for analyzing polymers irradiated by ions.** Rickards, J. (Universidad Nacional Autonoma de Mexico, Mexico City (Mexico). Inst. de Fisica); Zironi, E.P.; Andrade, E.; Dominguez, B. Japan Atomic Energy Research Inst., Tokyo (Japan). 1992. 817p. (CONF-911154–: International conference on evolution in beam applications, Takasaki (Japan), 5-8 Nov 1991). In *Proceedings of the international conference on evolution in beam applications.* Order Number DE93703820. Source: OSTI; NTIS; INIS.

In the study of the effects of ion beam irradiation of polymers very large doses can be administered in short times. Thousands of MGy can be produced in a small volume of a sample in a few minutes by bombarding with typical ion beam currents. For instance, in an experiment done to observe the effects of 750 keV proton irradiation PVC, using a collimator of 1 mm diameter, 1 μC of charge integration deposits a dose of 50 MGy. The use of ion beams also opens up the possibility of using the same beam for irradiation and for analysis of the effects, using the well known ion beam analysis techniques. PIXE allows the measurement of chlorine in PVC. Polymers containing fluorine can be measured with the resonant nuclear reaction (RNR) technique, which is specific only to certain elements. The amount of hydrogen in the sample and its profile can be obtained using energy recoil detection analysis (ERDA); carbon, oxygen, and nitrogen can be measured and profiled using Rutherford backscattering (RBS) and also using the (d,p) and (d, α) nuclear reactions (NR). Loss of mass is one effect that can be studied using these techniques. It was studied in two different polymers, PVC and CR-39, in order to determine carbon buildup during ion irradiation. It was concluded that carbon builds up following different mechanisms in these two materials, due to the different possibilities of forming volatile compounds. It is also suggested that CR-39 should be a good material for ion beam lithography. (author).

24033 (IS-T–1609) **Low temperature pathways to Chevrel phases via reduced molybdenum sulfide cluster complexes.** Shane, H. Ames Lab., IA (United States). 30 Mar 1993. 234p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-82. Order Number DE93013282. Source: OSTI; NTIS; GPO Dep.

The initial cluster compound, $Na_{2y}Mo_6S_{8+y}$ $(py)_x$, was discovered by reacting Mo_6Cl_{12} with higher stoichiometries of sodium hydrosulfide and sodium butoxide in butanol/pyridine. This compound can subsequently undergo ligand exchange reactions to form a variety of cluster complexes. Single-crystal structure determinations are reported for the pyridine (py), piperidine (pip), and pyrrolidine (pyrr)

complexes: triclinic $Mo_6S_8(PY)_6 \cdot 1.65py$, cubic $Mo_6S_8(py)_6 \cdot 2py$, $Mo_6S_8(pip)_6 \cdot 7pip$, and $Mo_6S_8(pyrr)_6 \cdot 1pyrr$. Delegation of the cluster complexes was explored. Direct heating under dynamic vacuum led to incomplete deligation. Reactions with tin and lead resulted in formation of corresponding Chevrel phase compounds along with MoS_2. Thermolysis reactions in the presence of flowing ammonia gas resulted in further delegation than was evidenced for reactions explored in vacuo. Solution reactions with strong acids were studied in an attempt to protonate the ligands and thus make them better leaving groups only limited success was achieved. A new preparative route was developed for ternary molybdenum sulfides. Cation exchange reactions with $Na_{2y}Mo_6S_{8+y}(MeOH)_x$ were used to form the cobalt, tin, lead, and holmium compounds. Preliminary hydrodesulfurization studies on the sodium and cobalt compounds showed that they possess larger surface areas and thiophene conversion percentages than Chevrel phases, but a lower HDS rate.

24034 (JAERI-M–93-013) **Chemical analysis of high purity graphite: Preparation of certified reference materials and development of analytical methods.** Japan Atomic Energy Research Inst., Tokyo (Japan). Mar 1993. 123p. (In Japanese). Order Number DE93797598. Source: OSTI; NTIS; INIS.

The Sub-Committee on Chemical Analysis of Graphite was organized in April 1989, under the Committee on Chemical Analysis of Nuclear Fuels and Reactor Materials, JAERI. The Sub-Committee carried out collaborative analyses among eleven participating laboratories for the certification of the Certified Reference Materials (CRMs), JAERI-G5 and G6, after developing and evaluating analytical methods during the period of September 1989 to March 1992. The certified values were given for ash, boron and silicon in the CRM based on the collaborative analysis. The values for ten elements (Al, Ca, Cr, Fe, Mg, Mo, Ni, Sr, Ti, V) were not certified, but given for information. Preparation, homogeneity testing and chemical analyses for certification of reference materials were described in this paper. (author) 52 refs.

24035 (LA-UR–93-1618) **Schemes for the use of conducting polymers as active materials in electrochemical supercapacitors.** Rudge, A. (Los Alamos National Lab., NM (United States)); Davey, J.; Gottesfeld, S.; Ferraris, J.P. Los Alamos National Lab., NM (United States). [1993]. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930571–14: 183. Electrochemical Society meeting, Honolulu, HI (United States), 16-21 May 1993). Order Number DE93012713. Source: OSTI; NTIS; GPO Dep.

The development of a novel conducting polymer based system for use in electrochemical capacitors is described. This system utilizes a new conducting polymer, poly-3-(4-fluorophenyl)-thiophene (PFPT), that can be reversibly n- and p-doped to high charge density. The electrochemical n-dopability of this material can be further improved by cycling in acetonitrile solution that contains a new electrolyte, tetramethylammonium trifluoromethanesulfonate ($Me_4NCF_3SO_3$). We discuss these improvements in n-dopability in terms of potential electronic and steric influences. We believe that the substituent fluorophenyl group does not communicate with the polythiophene backbone through resonance, and conclude that the ability to n-dope PFPT to high charge density may occur as a result of electron transfer reactions from the conducting polymer backbone into the substituent. This new system for electrochemical capacitors provides the best achievable performance from conducting polymers and generates high energy and power densities that are comparable with noble metal oxide systems, potentially at a fraction of the cost.

24036 (NAL-TR–1159) **Evaluation of test specimen shape effects on the flexural fatigue of CFRP laminates.** Noguchi, Y. (National Aerospace Laboratory, Tokyo (Japan)). National Aerospace Lab., Chofu, Tokyo (Japan). May 1992. 17p. (In Japanese). Order Number DE93793622. Source: OSTI; NTIS; Available from National Aerospace Laboratory, 44-1, Shindaiji Higashicho 7-chome, Chofu-City, Tokyo, Japan.

An investigation was made on relationship between a flexural fatigue test and test specimen shapes of carbon fiber reinforced plastic (CFRP). Five kinds of material were tested including carbon fibers with medium strength, high ductility, and high strength, cross-ply laminates as pre-preg base materials using epoxy resin for raw material, and pseudo isotropic laminates. Static bending test and flexural fatigue test were carried out for dynamic characteristics to derive the relationship (S-N line) between iterative bending stress and the number of repetition before breakdown. Comparison of the test results arrived at the following conclusions: The high-ductility and high-strength laminates exhibited significant difference in the S-N inclination, which is because of local compression breakdown at edges of the laminates; the flexural fatigue strength is compared in a descending order as the medium-strength laminates, high-ductility laminates, high-strength laminates, high-strength pseudo isotropic laminates, and medium-strength fabric laminates. The static bending strength was in the order of the high-strength laminates, high-ductility laminates, high-strength pseudo isotropic laminates, and medium-strength fabric laminates. 12 refs., 16 figs., 2 tabs.

24037 (NAL-TR–1160) **Tribological characteristics of hot-pressed self-lubricating composites.** Suzuki, M. (National Aerospace Laboratory, Tokyo (Japan)); Nishimura, M. National Aerospace Lab., Chofu, Tokyo (Japan). May 1992. 48p. (In Japanese). Order Number DE93793623. Source: OSTI; NTIS; Available from National Aerospace Laboratory, 44-1, Shindaiji Higashicho 7-chome, Chofu-City, Tokyo, Japan.

With an objective to develop lubricating materials for space applications with superior tribological characteristics, a hot press process was used to fabricate composite materials composed of MoS2, refractory metal oxides (MoO3, WO3, Ta2O5, and Nb2O5) and refractory metals (Nb, Mo, W and Ta). The composite materials were subjected to wear tests in a vacuum, N2 gas, and atmosphere. The best material composition under the sliding condition (face pressure at 0.5 MPa to 4 MPa and sliding velocity at 0.11 m/s to 0.55 m/s) was found to be MoS2 80% + MoO2 10% + Nb 10% (with a friction coefficient of 0.07 or lower and a specific friction amount of 10^{-11} $mm^3/mm \cdot N$ or less in a vacuum). Good tribological performance was also obtained with MoS2 80% + Nb2O5 10% + Nb 10% and MoS2 80% + MoO2 10% + Mo 10%. A feature common to the good composite materials is forming of uniform transfer film on surface of the opponent material. It was found that MoS2 decomposes producing Mo2S3 during hot-pressing the composite material. Greater wear in the atmosphere is because of production of MoO2 during friction. The effect of MoO2 addition is estimated to be in accelerating the MoS2 decomposition. 34 refs., 59 figs., 7 tabs.

24038 (NEI-NO–329) **Electrical and optical properties of multiple quantum well structures and their applications to infrared detectors.** Helgesen, P. Oslo Univ. (Norway). Apr 1992. [85p.] Order Number DE93625581. Source: OSTI; NTIS; INIS.

Reprints of seven previously printed papers are attached.

In this work the author investigate the subband nature of multiple quantum well structures by photoconductance spectroscopy, optical absorption measurements and tunneling experiments. Both interband and intraband transitions have been studied. The work is aimed at making an infrared detector using wide band gap semiconductors. 14 refs.

24039 (ORNL/FTR–4331) **[Travel to Germany for studies on carbon materials technology]: Foreign trip report, June 17–July 6, 1992.** Fuller, E.L. Jr. Oak Ridge National Lab., TN (United States). 21 Jul 1992. 31p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93012688. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Details of the traveler's meetings with research workers in Germany are reported. The meetings, held under the auspices of international agreements, were concemed with the exchange of data and technical information on graphite for high-temperature gas-cooled nuclear reactors. The presentations and ensuing discussions were eminently relevant and extremely beneficial to the traveler's research Work for the Modular High-Temperature Gas-Cooled Reactor (MHTGR) technology development program at Oak Ridge National Laboratory (ORNL).

24040 (ORNL/FTR–4388) **[Travel to Germany to attend the Third international conference on the new diamond science and technology]: Foreign trip report, August 29–September 10, 1992.** Clausing, R.E. Oak Ridge National Lab., TN (United States). 23 Sep 1992. 10p. Sponsored by USDOE, Washington,

DC (United States). DOE Contract AC05-84OR21400. Order Number DE93012111. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The conference and the post-conference visits allowed the traveler to access the status of CVD optical applications and structure control. It is apparent that at this time we, at ORNL, can grow and control a much wider range of CVD diamond textures than any other lab, however, we have strong competition in that the microwave technique of Koidl is able to exert very fine control of the growth of <100> textured material and that using the microwave techniques he can grow the material over a relatively wide range of temperatures. He has a fine staff and excellent facilities. We have planned collaborative activities to explore, differences in our techniques and results with both Koidl and Bachmann.

24041 (PNL-SA–21236) **Atomic polar tensors and acid-base properties of metal-oxide building blocks.** Ferris, K.F. Pacific Northwest Lab., Richland, WA (United States). Feb 1993. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-921101–113: 16. Material Research Society international symposium on the scientific basis for nuclear waste management fall meeting, Boston, MA (United States), 30 Nov - 5 dec 1992). Order Number DE93011034. Source: OSTI; NTIS; INIS; GPO Dep.

The sensitivity of the atomic polar tensor to compositional substituents is reported for the alkali silicate series. Rotational invariants, effective atomic charge (GAPT) and charge normalized anisotropy and dipole (α_n and γ_n) are used to characterize the charge distribution and chemical environment of the atomic sites. Comparison of α_n and γ_n with a series of known Bronsted and Lewis acids and bases suggests that these rotational invariants may act as indicators for metal-oxide site acidities. Basis set and electron correlation particularly affect the determined effective charge, but show minimal effect on α and γ quantities.

24042 (PNL-SA–21238) **Effects of surface defects on the local electric field in inhomogeneous media.** Ferris, K.F. (Pacific Northwest Lab., Richland, WA (United States)); Risser, S.M. Pacific Northwest Lab., Richland, WA (United States). Feb 1993. 9p. Sponsored by USDOE, Washington, DC (United States); Department of Defense, Washington, DC (United States); National Aeronautics and Space Administration, Washington, DC (United States); National Science Foundation, Washington, DC (United States). DOE Contract AC06-76RL01830. Grant CHE-9106689;Grant 91-NC-146. (CONF-921101–112: 16. Material Research Society international symposium on the scientific basis for nuclear waste management fall meeting, Boston, MA (United States), 30 Nov - 5 dec 1992). Order Number DE93011035. Source: OSTI; NTIS; INIS; GPO Dep.

Surface defects both focus the local electric field and enhance its intensity in the vicinity of the defect Using a finite element model of an inhomogeneous dielectric film, we have examined the relationship between the defect shape and local electric field in the film and defect. We find that raised defect regions that are peaked have the largest local fields while the slope of removed regions has little effect on the field in raised defects. Both peaked and flat surface defects can lead to large enhancements of the local electric field above that predicted by effective medium approximation (EMA) methods.

24043 (PNL-SA–21812) **Sensing glass transitions in thin polymer films on acoustic wave microsensors.** Grate, J.W. Pacific Northwest Lab., Richland, WA (United States). Mar 1993. 24p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-930398–2: American Society of Testing and Materials (ASTM) meeting on glass transition, Atlanta, GA (United States), 4-5 Mar 1993). Order Number DE93010805. Source: OSTI; NTIS; GPO Dep.

Acoustic wave microsensors are capable of sensing transition behaviors of homogeneous amorphous polymers applied as thin films to the surface of the sensors. The device and wave characteristics of four such microsensors, and examples of their uses in monitoring polymer properties, are described. The devices are the thickness-shear mode (TSM), surface acoustic wave (SAW), flexural plate wave (FPW), and shear horizontal acoustic plate mode (SH-APM) devices. Using the FPW device, the change in the polymer coefficient of thermal expansion at the static glass transition temperature is sensed as a change in slope of the frequency-temperature plot. This behavior reflects the fact that the frequency measures acoustic velocity, which decreases as the polymer modulus decreases. Modulus decreases as the polymer volume increases. Frequency-dependent relaxation properties are detected with a sigmoidal change in slope of the frequency-temperature plot and a maximum in signal amplitude. The minimum in signal amplitude is analogous to the maximum in the loss tangent in dynamic mechanical analysis, or the maximum in sound damping in bulk-wave ultrasonic studies.

24044 (SAND–92-0824C) **Free-exciton recombination in GaAs.** Wolford, D.J. (Thomas J. Watson Research Center, Yorktown Heights, NY (United States)); Gilliland, G.D.; Kuech, T.F.; Bradley, J.A.; Hjalmarson, H.P. Sandia National Labs., Albuquerque, NM (United States). [1992]. 5p. Sponsored by USDOE, Washington, DC (United States); Department of Defense, Washington, DC (United States). DOE Contract AC04-76DP00789. Contract N00014-85-C-0868;Contract N00014-90-C0077;Contract N000 (CONF-930880–3: International conference on the physics of semiconductors, Beijing (China), 10-14 Aug 1993). Order Number DE93009843. Source: OSTI; NTIS; GPO Dep.

We have studied the kinetics of free-exciton recombination in "ideal" GaAs structures. Our studies include detailed photoluminescence kinetics measurements versus laser excitation power, temperature, sample structure, and surface treatment. The primary goal in these studies is to understand the mechanism precipitating free-exciton recombination, and the role, if any, that polaritons play. Additionally, we have assessed the effects free-carriers and a variety of different sample structures and surface treatments have on these kinetics.

24045 (SAND–92-0825C) **Anomalous low-temperature free-exciton transport in GaAs structures.** Wolford, D.J. (T.J. Watson Research Center, Yorktown Heights, NY (United States). IBM Research Div.); Gilliland, G.D.; Kuech, T.F.; Bradley, J.A.; Hjalmarson, H.P. Sandia National Labs., Albuquerque, NM (United States). [1992]. 4p. Sponsored by USDOE, Washington, DC (United States); Department of Defense, Washington, DC (United States). DOE Contract AC04-76DP00789. Contract N00014-85-C-0868;Contract N00014-90-C-0077;Contract N00 (CONF-930880–2: International conference on the physics of semiconductors, Beijing (China), 10-14 Aug 1993). Order Number DE93009845. Source: OSTI; NTIS; GPO Dep.

Using an optical analogue to the classical Haynes-Schockley experiment, we have studied low-temperature free-exciton transport in several "ideal" GaAs structures. We find the observed diffusion constants to be laser excitation power dependent below 50 K, and independent of laser power at higher temperatures. We observe peak 2 K diffusivities of > 1000 cm^2/Vs. Possible mechanisms are discussed.

24046 (SAND–92-2498C) **Crack suppression in GaInSb buffer layers initially under tensile stress.** Drummond, T.J.; Lee, S.R. Sandia National Labs., Albuquerque, NM (United States). [1992]. 22p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-930405–2: Spring meeting of the Materials Research Society, San Francisco, CA (United States), 12-16 Apr 1993). Order Number DE93012839. Source: OSTI; NTIS; GPO Dep.

Epitaxial III-V compound semiconductor buffer layers typically relieve tensile stress by mixed crack and misfit dislocation formation. Crack suppression by p-doping GaInSb step graded buffers grown on InSbsubstrates by MBE is demonstrated. This complements a similar demonstration for InAsSb buffers grown by MOCVD. The depth dependence and reproducibility of the stress relaxation have been quantified using a novel k-map x-ray analysis. A model in which the p-doping enhances the nucleation and subsequent climb of dislocations has been formulated to explain the result. This model should also apply to other III-V buffer systems such as GaAsP/GaAs and InGaAs/InP.

24047 (SAND–93-0609C) **Intrinsic and interfacial recombination in OMVPE- and MBE-prepared $GaAs/Al_xGa_{1-x}As$ heterostructures.** Gilliland, G.D. (International Business Machines Corp., Yorktown Heights, NY (United States). Thomas J. Watson

Research Center); Wolford, D.J.; Kuech, T.F.; Bradley, J.A.; Klem, J.; Hjalmarson, H.P. Sandia National Labs., Albuquerque, NM (United States); International Business Machines Corp., Yorktown Heights, NY (United States). Thomas J. Watson Research Center. [1993]. 4p. Sponsored by USDOE, Washington, DC (United States); Department of Defense, Washington, DC (United States). DOE Contract AC04-76DP00789. Contract N00014-85-C-0868;Contract N00014-90-C-0077;Contract N00 (CONF-930880–1: International conference on the physics of semiconductors, Beijing (China), 10-14 Aug 1993). Order Number DE93009844. Source: OSTI; NTIS; GPO Dep.

We have studied intrinsic free-carrier recombination in a variety of GaAs structures, including: OMVPE- and MBE-prepared GaAs/$Al_xGa_{1-x}As$ double heterostructures, Na_2S passivated GaAs structures and bare GaAs structures. We find OMVPE prepared structures are superior to all of these other structures with 300 K lifetimes of $\sim$ 2.5 μs and negligible nonradiative interface and bulkrecombination, and thus are truly surface-free ($S < 40$ cm/s). Moreover, we observe systematic trends in optical properties versus growth conditions. Lastly, we find that the presence of free-exciton recombination in the low-temperature photoluminescence spectra is a necessary but not sufficient condition for optimal optical properties (i.e. long minority-carrier lifetimes).

24048 (SAND–93-0825C) **Preparation of carbon monoliths having tailored pore structure from porous polymer precursors.** Lagasse, R.R. Sandia National Labs., Albuquerque, NM (United States). [1993]. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-930615–1: Biennial conference on carbon, Buffalo, NY (United States), 13-18 Jun 1993). Order Number DE93011576. Source: OSTI; NTIS; INIS; GPO Dep.

This work concerns preparing tailored porous carbon monoliths by pyrolyzing porous polymer precursors. Prior work in this laboratory (1) demonstrated that a low density (0.05 g/cm^3), high void fraction (97 vol%) carbon monolith could be prepared by pyrolyzing a porous poly(acrylonitrile) (PAN) precursor. A higher density, more robust carbon material is preferred for certain applications, such as electrodes for electrochemical devices. The present work demonstrates that porous carbon monoliths having mass density of 0.7 g/cm^3 can be prepared from a porous PAN precursor if the pyrolysis is controlled carefully. The macropore structure of the carbon is adjusted by changing the pore structure of the PAN precursor, and the finer scale structure (such as the crystallite size L_c) is adjusted by varying the pyrolysis or heat treatment temperature.

24049 (SAND–93-0826C) **Correlations of the growth, structure and stress with the adhesion of diamond films on tungsten.** Alam, M. (New Mexico Inst. of Mining and Technology, Socorro, NM (United States). Dept. of Materials Engineering); Peebles, D.E.; Tallant, D.R.; Ohlhausen, J.A. Sandia National Labs., Albuquerque, NM (United States). [1993]. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-930419–1: International conference on metallurgical coatings and thin films, San Diego, CA (United States), 19-23 Apr 1993). Order Number DE93012855. Source: OSTI; NTIS; GPO Dep.

Diamond films were deposited on tungsten substrates by a filament-assisted chemical vapor deposition process as a function of seven different processing parameters. The effect of variations in measured film characteristics such as growth rate, texture, diamond-to-nondiamond carbon Raman band intensity ratio and strain on the adhesion between the diamond film/tungsten substrate pairs as measured by a tensile pull method were investigated. The measured adhesion values do not correlate with any of the measured film characteristics mentioned above. The problem arises because of the non-reproducibility of the adhesion test results, due to the non-uniformity of film thickness, surface preparation and structural homogeneity across the full area of the substrate.

24050 (SAND–93-1020C) **Rapid thermal processing for strained-layer semiconductor devices.** Zolper, J.C.; Myers, D.R. Sandia National Labs., Albuquerque, NM (United States). [1993]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-930405–6: Spring meeting of the Materials Research Society, San Francisco, CA (United States), 12-16 Apr 1993). Order Number DE93013754. Source: OSTI; NTIS; GPO Dep.

Strained-layer semiconductors have revolutionized modern heterostructure devices by exploiting the modification of semiconductor band structure associated with the coherent strain of lattice-mismatched heteroepitaxy. The modified band structure improves transport of holes in heterostructures and enhances the operation of semiconductor lasers. Strained-layer epitaxy also can create materials whose band gaps match wavelengths (e.g. 1.06 μm and 1.32 μm) not attainable in ternary epitaxial systems lattice matched to binary substrates. Other benefits arise from metallurgical effects of modulated strain fields on dislocations. Lattice mismatched epitaxial layers that exceed the limits of equilibrium thermodynamics will degrade under sufficient thermal processing by converting the as-grown coherent epitaxy into a network of strain-relieving dislocations. After presenting the effects of strain on band structure, the authors describe the stability criterion for rapid-thermal processing of strained-layer structures and the effects of exceeding the thermodynamic limits. Finally, device results are reviewed for structures that benefit from high temperature processing of strained-layer superlattices.

24051 (UCRL-JC–105732) **Second and third order nonlinear optical properties of crystalline inorganic/organic complexes.** Marcy, H.O. (Rockwell International Corp., Thousand Oaks, CA (United States). Science Center); Warren, L.F.; Davis, L.E.; Webb, M.S.; Velsko, S.P. Lawrence Livermore National Lab., CA (United States). Jul 1992. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9105418–1: 1991 Spring Materials Research Society (MRS) meeting, Baltimore, MD (United States), May 1991). Order Number DE93011883. Source: OSTI; NTIS; GPO Dep.

Properties for members of a new class of nonlinear optical (NLO) materials which stoichiometrically incorporate organic and inorganic constituents into a single crystalline lattice are reported. Recent results for our synthetic, crystal growth, and optical studies suggest that a number of these relatively transparent "semiorganic" compounds have significant second and/or third order NLO responses and often display favorable crystal growth morphologies. The prototype material of this class zinc tris(thiourea) sulfate, or ZTS, has a UV cutoff at about 325 nm, can be readily grown to cm^3 sizes, and has been shown to be a highly efficient Type II frequency doubler for 1064 nm Nd:Yag laser radiation. ZTS also processes a moderate third order nonlinear optical response (ca. $0.1 \times CS_2$) which occurs on at least a picosecond time scale as determined by degenerate four-wave mixing (DFWM) experiments at 532 nm. Refractive index, second harmonic generation, and DFWM data for a number of these new compounds are presented.

24052 (UCRL-JC–110245) **Automated net shaped molding of continuous fiber composites.** Spellman, G. (Lawrence Livermore National Lab., CA (United States)); Dodson, J.D.; Dittmer, W.D. Lawrence Livermore National Lab., CA (United States); Sparta, Inc., San Diego, CA (United States). Apr 1992. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9204112–3: 2. small satellite technology and applications, Orlando, FL (United States), 20-24 Apr 1992). Order Number DE93012484. Source: OSTI; NTIS; GPO Dep.

Composite materials have demonstrated performance benefits for a variety of satellite applications. Now, an emphasis on smaller, more specialized satellites produced in higher quantities than before is emerging. Due to the competitive economic environment, realization of cost reduction potential by the use of composite materials is critical. Producibility techniques, long employed by other aerospace segments, offer an approach to cost reduction while retaining improved performance. One cost reduction approach is to reduce the number of piece parts and assembly operations by converting from a metal-based design to one based on composite technology. Alternate composite fabrication approaches can then be compared for thermoplastic and thermoset matrices for additional producibility benefits based on properties and comparative costs. Previously developed representative data are presented for this transition from a metallic component to composite and for alternate fabrication approaches. The next step in cost reduction would appear to be the introduction of automation techniques and

minimizing post fabrication operations while maintaining performance properties. The program described in section 3 is structured to provide a key confirming experiment to demonstrate that such a goal can be realized.

24053 (UCRL-JC–110334) **Damping measurements for ultra-high carbon steel/brass laminates.** Bonner, B.P. (Lawrence Livermore National Lab., CA (United States)); Lesuer, D.R.; Syn, C.K.; Brown, A.E.; Sherby, O.D. Lawrence Livermore National Lab., CA (United States). 26 Oct 1992. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9211117–6: Minerals, Metals, and Materials Society/American Society for Metals (TMS/ASM) materials week '92, Chicago, IL (United States), 2-5 Nov 1992). Order Number DE93011886. Source: OSTI; NTIS; GPO Dep.

Damping measurements were made at high and low frequencies to investigate laminated metal composites (LMCs) ultrahigh carbon steel and brass for use in applications that require high damping capacity while maintaining strength and toughness. Properties of such laminates can be tailored through the selection of the component materials, volume percentage of the materials, layer thickness, interface strength and microstructural control. Damping was measured in the ultrasonic range (2.25 MHz) with pulse-echo torsional oscillator from 2 to 40 Hz in shear strain range 10^{-7} to 10^{-6}. Results at low frequencies indicate that Q_s^{-1} is 2 to 3 times higher than that of the highest damping component (brass). Damping is also independent of the layer orientation. Ultrasonic attenuation is much larger than for the component materials, with insertion losses ~100 dB/m greater than either component. Microstructure (metallography, SEM) and correlations between laminate structure and damping behavior are discussed.

24054 (UCRL-JC–111396) **Zerodur polishing process for high surface quality and high efficiency.** Tesar, A.; Fuchs, B. Lawrence Livermore National Lab., CA (United States). Aug 1992. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9211104–8: OPTCON '92: optical fabrication and testing workshop, Boston, MA (United States), 17 Nov 1992). Order Number DE93012596. Source: OSTI; NTIS; INIS; GPO Dep.

Zerodur is a glass-ceramic composite importance in applications where temperature instabilities influence optical and mechanical performance, such as in earthbound and spaceborne telescope mirror substrates. Polished Zerodur surfaces of high quality have been required for laser gyro mirrors. Polished surface quality of substrates affects performance of high reflection coatings. Thus, the interest in improving Zerodur polished surface quality has become more general. Beyond eliminating subsurface damage, high quality surfaces are produced by reducing the amount of hydrated material redeposited on the surface during polishing. With the proper control of polishing parameters, such surfaces exhibit roughnesses of <lÅ rms. Zerodur polishing was studied to recommend a high surface quality polishing process which could be easily adapted to standard planetary continuous polishing machines and spindles. This summary contains information on a polishing process developed at LLNL which reproducibly provides high quality polished Zerodur surfaces at very high polishing efficiencies.

24055 (UCRL-JC–111969) **The optical constants and spectral specular reflectivity of highly oriented pyrolytic graphite (HOPG).** Havstad, M.A.; Schildbach, M.A.; McLean, W. II. Lawrence Livermore National Lab., CA (United States). Oct 1992. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-930830–11: National conference and exposition on heat transfer, Atlanta, GA (United States), 8-11 Aug 1993). Order Number DE93011894. Source: OSTI; NTIS; GPO Dep.

The measurements were made using two independent optical systems, with good agreement. The spectral directional-hemispherical reflectivity at normal incidence varies from 0.41 at 0.55 μm to 0.74 at 8.45 μm. Components of complex index of refraction increase smoothly with wavelength, the index increasing from 3.10 at 0.55 μm to 7.84 at 8.45 μm. Extinction coefficient varies from 2.01 to 6.66 over the same range. An attempt was made to fit the complex index to a model with both free and bound carriers. (DLC)

24056 (UCRL-JC–112312) **Investigation of optically generated electronic defects and protonic transport in hydrogen-bonded molecular solids: Isomorphs of potassium dihydrogen phosphate.** Davis, J.E. (California Univ., Davis, CA (United States). Dept. of Applied Science); Hughes, R.S. Jr.; Lee, H.W.H. Lawrence Livermore National Lab., CA (United States). Oct 1992. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-930586–5: Quantum electronics and laser science conference, Baltimore, MD (United States), 2-7 May 1993). Order Number DE93012498. Source: OSTI; NTIS; GPO Dep.

We present a coherent picture of a new class of defects that appear to affect hydrogen-bonded molecular solids represented in this study by isomorphs of KDP (DKDP, KDP, ADP). We also discuss the effects this defect has on two photon absorption measurements and the harmonic generation of UV pulses.

24057 (WSRC-MS–93-135) **Evaluation of seismic spatial interaction effects through an impact testing program.** Thomas, B.D.; Driesen, G.E. Westinghouse Savannah River Co., Aiken, SC (United States). [1993]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. (CONF-930702–13: Pressure vessel and piping conference, Denver, CO (United States), 25-29 Jul 1993). Order Number DE93010376. Source: OSTI; NTIS; GPO Dep.

The consequences of non-seismically qualified objects falling and striking essential, seismically qualified objects is an analytically difficult problem to assess. Analytical solutions to impact problems are conservative and only available for simple situations. In a nuclear facility, the numerous "sources" and "targets" requiring evaluation often have complex geometric configurations, which makes calculations and computer modeling difficult. Few industry or regulatory rules are available for this specialized assessment. A drop test program was recently conducted to "calibrate" the judgment of seismic qualification engineers who perform interaction evaluations and to further develop seismic interaction criteria. Impact tests on varying combinations of sources and targets were performed by dropping the sources from various heights onto targets that were connected to instruments. This paper summarizes the scope, test configurations, and some results of the drop test program. Force and acceleration time history data and general observations are presented on the ruggedness of various targets when subjected to impacts from different types of sources.

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24058 (CONF-920791–, pp. 6, Paper 7) **On-site infrared analyses for complex systems.** Jones, R.W. (Ames Lab., IA (US)); Ochiai, S.; McClelland, J.F. USDOE Assistant Secretary for Environmental Restoration and Waste Management, Washington, DC (United States). Jul 1992. From Information exchange meeting on characterization sensors and monitoring technologies; Dallas, TX (United States); 15-16 Jul 1992. In *Proceedings of the information exchange meeting on characterization, sensors, and monitoring technologies.* 261p. Order Number DE93005318. Source: OSTI; NTIS.

Infrared spectroscopy has long been a powerful analysis tool in the laboratory. Only recently, however. has it moved from the lab into the field or onto the industrial process line. Conventional spectroscopic methods often involve equipment (e.g., delicate long-pathlength cells) or sample-preparation methods (e.g.. grinding and dilution) that are difficult to use out side the laboratory. This project we uses two unconventional techniques requiring no delicate equipment and little or no sample preparation to bring the capabilities of infrared spectroscopy out of the laboratory or to materials

that are difficult to handle. The techniques are photoacoustic spectroscopy (PAS) and transient infrared spectroscopy (TIRS). The authors use PAS to acquire infrared spectra of volatile organic compounds (VOCs) in air, water, and soil samples in the field, so that the VOCs may be identified and their concentrations measured. PAS is also being used in the laboratory to examine radioactive materials because it requires very little sample handling and minimal sample volume. TIRS is an on-line technique for acquiring the infrared spectra of solids and viscous liquids. It is being developed as a real-time monitor for the polyethylene encapsulation of radioactive wastes that is being developed at Brookhaven National Laboratory and being tested at Rocky Flats Plant. These three applications of PAS and TIRS are discussed in detail.

24059 (CONF-920791–, pp. 9, Paper 9) **Progress in the development of indwelling probes for chlorinated organic solvents.** Daley, P.F. (Lawrence Livermore National Lab., CA (US)); Colston, B.; Brown, S.; Milanovich, F. USDOE Assistant Secretary for Environmental Restoration and Waste Management, Washington, DC (United States). Jul 1992. From Information exchange meeting on characterization sensors and monitoring technologies; Dallas, TX (United States); 15-16 Jul 1992. In *Proceedings of the information exchange meeting on characterization, sensors, and monitoring technologies.* 261p. Order Number DE93005318. Source: OSTI; NTIS.

A fiber optic sensor technology for the remote detection of trichloroethlyene (TCE) and chloroform has been developed. In laboratory studies, sensitivity below the EPA drinking water compliance level has been demonstrated for both TCE and chloroform. The efficacy of this technology for remediation activities is currently being evaluated at the Savannah River Integrated Demonstration project. Instrumentation for TCE detection has been developed and field tests of the TCE sensor in vadose zone and groundwater monitoring wells have been successfully conducted. A penetrometer implant of the TCE sensor was performed in late May, 1992. The technology has been transferred to industry by means of a field-of-use license. The licensee, Purus Corp., San Jose, CA will implement the sensor in above-ground remediation equipment. A license for vadose zone and groundwater applications is currently in negotiation. The technology will be transferred to SRS during FY 93.

24060 (CONF-920791–, pp. 7, Paper 10) **Characterization and monitoring of total organic chloride vapors.** Anheier, N.C. Jr. (Pacific Northwest Lab., Richland, WA (US)); Evans, J.C. Jr.; Olsen, K.B. USDOE Assistant Secretary for Environmental Restoration and Waste Management, Washington, DC (United States). Jul 1992. From Information exchange meeting on characterization sensors and monitoring technologies; Dallas, TX (United States); 15-16 Jul 1992. In *Proceedings of the information exchange meeting on characterization, sensors, and monitoring technologies.* 261p. Order Number DE93005318. Source: OSTI; NTIS.

Between the extremes represented by highly selective methods on the other (i.e., PID) lies an intermediate case of great interest for use at a large number of sites where the contamination setting is narrowly defined. A number of emerging chemical sensor development efforts have taken that approach. Such sensors find broad applicability in situations where the contamination issue or contamination potential is reasonably unambiguous. For example, if early warning is required for potential leaking of an underground storage tank containing gasoline, the sensor used should respond to a range of indicator species present in gasoline such as the BTEX fraction. A similar situation occurs during remediation of a well-characterized site such as is the case at the Savannah River M Area where trichloroethylene (TCE) and tetrachloroethylene (PCE) are clearly established as the dominant ground water and vadose zone contaminants requiring remediation, or the Hanford 200 West Area site where carbon tetrachloride (CCl_4) is well established as dominant. In those cases, a detector capable of monitoring total organic chlorinated compounds (TOCl) in real time and over a wide dynamic range is clearly beneficial. PNL is currently evaluating such a system for applicability to characterization and monitoring at the Savannah River Integrated Technology Demonstration Project and the Hanford VOC-Arid Integrated Technology Demonstration. The system is capable of measuring TOC1 in real time on an extracted gas sample over a wide linear dynamic range. The baseline technology used for comparison is an electrochemical sensor packaged as a field portable TOCl detection system. An optical-emission based TOCL sensor (Halosnif) developed by PNL appears to offer some distinct advantages over electrochemical sensors and other relevant baseline technologies.

24061 (CONF-920791–, pp. 6, Paper 14) **Contaminant analysis automation.** Erkkila, T.H. (Los Alamos National Lab., NM (US)); Hollen, R.M.; Beugelsdijk, T.J. USDOE Assistant Secretary for Environmental Restoration and Waste Management, Washington, DC (United States). Jul 1992. From Information exchange meeting on characterization sensors and monitoring technologies; Dallas, TX (United States); 15-16 Jul 1992. In *Proceedings of the information exchange meeting on characterization, sensors, and monitoring technologies.* 261p. Order Number DE93005318. Source: OSTI; NTIS.

The Department of Energy (DOE) has significant amounts of radioactive and hazardous wastes stored, buried, and still being generated at many sites within the United States. These wastes must be characterized to determine the elemental, isotopic, and compound content before remediation can begin. The authors project that sampling requirements will necessitate generating more than 10 million samples by 1995, which will far exceed the capabilities of current manual chemical analysis laboratories. The Contaminant Analysis Automation effort (CAA), with Los Alamos National Laboratory (LANL) as the coordinating Laboratory, is designing and fabricating robotic systems that will standardize and automate both the hardware and the software of the most common environmental chemical methods. This will be accomplished by designing and producing several unique analysis systems called Standard Analysis Methods (SAM). Each SAM will automate a specific chemical method, including sample preparation, the analytical analysis, and the data interpretation, by using a building block known as the Standard Laboratory Module (SLM). This concept allows the chemist to assemble an automated environmental method using standardized SLMs easily and without the worry of hardware compatibility or the necessity of generating complicated control programs.

24062 (CONF-920791–, pp. 7, Paper 34) **Direct analysis of involatile contaminants using molecular beam surface analysis (In situ SIMS analysis).** Groenewold, G.S. (EG & G Idaho, Inc., Idaho Falls (US)); Appelhans, A.D.; Ingram, J.C.; Delmore, J.E. USDOE Assistant Secretary for Environmental Restoration and Waste Management, Washington, DC (United States). Jul 1992. From Information exchange meeting on characterization sensors and monitoring technologies; Dallas, TX (United States); 15-16 Jul 1992. In *Proceedings of the information exchange meeting on characterization, sensors, and monitoring technologies.* 261p. Order Number DE93005318. Source: OSTI; NTIS.

A new program was initiated in March, 1992, at the Idaho National Engineering Laboratory (INEL) to develop rapid and sensitive analyses of surfaces for involatile contaminants, such as complexing agents and their metal complexes especially radioisotopes. Advances in primary beam technology and target surface neutralization have made it possible to analyze certain contaminants on surfaces such as leaves, building materials, and rocks, without the need for sample preparation. It is the objective of the first year of the program to assess the efficacy of molecular beam surface analysis for the direct detection of contaminants on these insulating surfaces.

24063 (DOE/ER/13357–22) **Interfacial chemistry in solvent extraction systems: Progress report, June 1, 1992–May 31, 1993.** Neuman, R.D. Auburn Univ., AL (United States). Dept. of Chemical Engineering. Jan 1993. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG05-85ER13357. Order Number DE93015526. Source: OSTI; NTIS; GPO Dep.

Research this past year continued to emphasize characterization of the physicochemical nature of the microscopic interfaces, i.e., reversed micelles and other association microstructures, which form in both practical and simplified acidic organophosphorus extraction systems associated with Ni, Co, and Na in order to improve on the model for aggregation of metal-extractant complexes.

Also, the macroscopic interfacial behavior of model extractant (surfactant) molecules was further investigated. 1 fig.

24064 (DOE/ER/14187–1) **[Linear and nonlinear spectroscopic probing of solute interactions with chemically modified silica surface]: Progress report.** Delaware Univ., Newark, DE (United States). [1993]. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-91ER14187. Order Number DE93014648. Source: OSTI; NTIS; GPO Dep.

Objective is to understand the surface science underlying liquid chromatographic separations, enabling improvements in design of chromatographic stationary phases. Progress was made both in use of laser spectroscopy to probe chromatographic surfaces and in developing new stationary phases based on self-assembled monolayers.

24065 (DOE/ER/75582–T1) **[Surface science instrumentation for the study of important catalytic and electrochemical interfaces]: Annual technical report.** California Inst. of Tech., Pasadena, CA (United States). Dept. of Chemistry. [1992]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG05-90ER75582. Order Number DE93015068. Source: OSTI; NTIS; GPO Dep.

The equipment combines several standard surface science probes (uv photoelectron spectra, thermal desorption, AES) with a state-of-the art x-ray photoelectron spectrometer and integrates with a dry box and a custom electrochemical cell. After the LEED chamber was remachined, the instrument has been performing satisfactorily. Various studies using the instrument were conducted in cooperation with other groups. Si surfaces were studied before and after use as a photoanode in a photoelectrochemical cell.

24066 (DOE/ID/12691–T5) **On-line chemical composition analyzer development: Status report, February 1, 1993–April 30, 1993.** Garrison, A.A. Tennessee Univ., Knoxville, TN (United States). Measurement and Control Engineering Center. [1993]. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC02-88ID12691. Order Number DE93014838. Source: OSTI; NTIS; GPO Dep.

This report relates to the development of an on-line Raman analyzer for control of a distillation column. It is divided into: program issues, experimental control system evaluation, energy savings analysis, and reliability analysis. (DLC)

24067 (DOE/METC/C–93/7065) **On-line, multielement ICP spectrometer for application to high temperature and pressure fossil fuel process streams.** Romanosky, R.R.; Viscomi, A.S.; Miller, S.S.; Chisholm, W.P. USDOE Morgantown Energy Technology Center, WV (United States). [1993]. 7p. Sponsored by USDOE, Washington, DC (United States). (CONF-930304–18: 205. American Chemical Society national meeting, Denver, CO (United States), 28 Mar - 2 apr 1993). Order Number DE93011587. Source: OSTI; NTIS; GPO Dep.

METC is developing a real-time, multielement ICP spectrometer system for application to high temperature and high pressure fossil fuel process streams. The ICP torch operates on a mixture of argon and helium with a conventional annular swirl flow plasma gas, no auxiliary gas, and a conventional sample stream injection through the base of the plasma flame. The base of the torch body is a unique design, allowing process gas at 650°C to be injected into the torch. The RF generator (40.68 MHz) can deliver 10 kW, but the best detection limits have been observed at 5 kW. The detection system is a quartz fiber optic bundle mated to a battery of one-tenth meter monochromators with photomultiplier tubes. A microcomputer controls scanning of the monochromators and data acquisition from the PMTs. The METC ICP system is modular and mobile, allowing the system to be operated in close proximity to any process of interest. Previous work by other researchers [1] focused on monitoring of liquid phase process streams and looked only at elements at a relatively high concentration. Process monitoring by ICP spectrometry under conditions relevant to METC's advanced technologies has not been previously reported. The principle reason for this lack of progress is the difficulty of sustaining a stable plasma discharge around a high flow of carbon-containing sample gas.

24068 (DOE/PC/92521–T33) **Production of carbon molecular sieves from Illinois coal: Technical report, December 1, 1992–February 28, 1993.** Lizzio, A.A. (Illinois Dept. of Energy and Natural Resources, Springfield, IL (United States). Geological Survey); Rostam-Abadi, M.; Banerjee, D.D. Illinois Dept. of Energy and Natural Resources, Springfield, IL (United States). 1993. 30p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC22-92PC92521. Order Number DE93013653. Source: OSTI; NTIS; GPO Dep.

Carbon molecular sieves (CMS) have become an increasingly important class of adsorbents for use in gas separation and recovery processes. The overall objective of this project is to determine whether Illinois Basin coals are suitable feedstocks for the production of CMS and to evaluate the potential application of these products in commercial gas separation processes. In Phase 1 of this project, gram quantities of char were prepared from Illinois coal in a fixed-bed reactor under a wide range of pyrolysis and activation conditions. Chars having surface areas of 1500–2100 M^2/g were produced by chemical activation using potassium hydroxide (KOH) as the activant. These high surface area chars had more than twice the adsorption capacity of commercial molecular sieves. The kinetics of adsorption of various gases, e.g., N_2, O_2, CO_2, CH_4, CO and H_2, on these chars at 25°C was determined. Several chars showed good potential for efficient O_2/N_2, CO_2/CH_4, CO_2/H_2 and CH_4/H_2 separation; both a high adsorption capacity and selectivity were achieved. The full potential of these materials in commercial gas separations has yet to be realized. In Phase 2 of this project, currently in progress, larger quantities of char are being prepared from Illinois coal in a batch fluidized-bed reactor (FBR) and in a continuous rotary tube kiln (RTK). The pore structure of the prepared chars will be tailored for a specific gas separation process by activation in CO_2 and H_2O and/or carbon deposition with CH_4.

24069 (DOE-RAS–92.009) **Development of natural matrix reference materials for monitoring environmental radioactivity.** Holmes, A.S. (Laboratory of the Government Chemist (United Kingdom)); Houlgate, P.R.; Pang, S.; Brookman, B. Department of the Environment, London (United Kingdom). Radioactive Substances Div. 1992. [77p.] Contract PECD-7/9/447;ES1/RC/15/14/01. Order Number DE93624271. Source: OSTI; NTIS (US Sales Only); INIS.

The Department of the Environment commissioned the Laboratory of the Government Chemist to carry out a contract on natural matrix reference materials. A survey of current availability of such materials in the western world, along with the UK's need, was conducted. Four suitable matrices were identified for production and validation. Due to a number of unforeseen problems with the collection, processing and validation of the materials, the production of the four identified reference materials was not completed in the allocated period of time. In the future production of natural matrix reference materials the time required, the cost and the problems encountered should not be underestimated. Certified natural matrix reference materials are a vital part of traceability in analytical science and without them there is no absolute method of checking the validity of measurement in the field of radiochemical analysis. (author).

24070 (EGG-WTD–10507) **In situ secondary ion mass spectrometry analysis: 1992 Summary report.** Groenewold, G.S.; Applehans, A.D.; Ingram, J.C.; Delmore, J.E.; Dahl, D.A. EG and G Idaho, Inc., Idaho Falls, ID (United States). Jan 1993. 31p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-76ID01570. Order Number DE93012185. Source: OSTI; NTIS; GPO Dep.

The direct detection of tributyl phosphate (TBP) on rocks using molecular beam surface analysis [MBSA or in situ secondary ion mass spectrometry (SIMS)] is demonstrated. Quantities as low as 250 ng were detected on basalt and sandstone with little or no sample preparation. Detection of TBP on soil has proven to be more problematic and requires further study. Ethylenediaminetetraacetic acid (EDTA) is more difficult to detect because it is very reactive with surfaces of interest. Nevertheless, it is possible to detect EDTA if the acidity of the surface is controlled. The detection of EDTA-metal complexes is currently an open question, but evidence is presented for the detection of ions arising from a

EDTA-lead complex. Carboxylic acids (i.e., citric, ascorbic, malic, succinic, malonic, and oxalic) give characteristic SIM spectra, but their detection on sample surfaces awaits evaluation.

24071 (IAEA-TECDOC–683) **Development and evaluation of alternative radioanalytical methods, including mass spectrometry for marine materials: Proceedings of an advisory group meeting held in Monaco, 6-9 June 1989.** International Atomic Energy Agency, Vienna (Austria). Jan 1993. [95p.] (CONF-8906428–: Advisory group meeting on development and evaluation of alternative radioanalytical methods, including mass spectrometry for marine materials, Monaco (Monaco), 6-9 Jun 1989). Order Number DE93625117. Source: OSTI; NTIS (US Sales Only); INIS.

One, if not the most important, aspect of environmental protection against radioactive contamination is the ability to measure accurately low-levels of radionuclides present in the environment. This is particularly true of the marine environment where improved and more rapid methods of analysis are required to identify the source and radiological impact of anthropogenic inputs to the oceans. More sensitive and rapid analytical methods with smaller analytical errors are required to study the behaviour of different radionuclides in the marine environment. Some of these radionuclides serve as useful research tracers that aid in understanding many complex oceanographic processes. With the ever-increasing demand for more accurate data, the IAEA considered it necessary to convene an Advisory Group Meeting to identify those long-lived radionuclides that may be measured by alternative techniques and discuss and evaluate the sensitivity of the analytical methods. The meeting was held at the IAEA Marine Environment Laboratory in Monaco from 6 to 9 June 1989 and was attended by 6 invited participants and several observers. This report from the meeting is divided into two parts. The first contains 5 contributing chapters. In these chapters the authors have endeavored to explain the principles of each measurement technique, the strengths and weakness of the method as applied to marine sciences, comparative costs and sensitivities, future developments and topics of interest to the Agency. The reviews and sensitivities were prepared exclusively by the participants on the basis of their own experience and knowledge of the existing literature. The second part of this report is the appendices section in which can be found tables of radionuclides considered in this report and a comparison of sensitivities for different methods of detection. Refs, figs and tabs.

24072 (IAEA-TECDOC–683, pp. 7-23) **Conventional radiometric methods of analysis including neutron activation.** Harvey, B.R. (Ministry of Agriculture, Fisheries and Food, Lowestoft (United Kingdom). Fisheries Radiobiological Lab.); Chazal, A. International Atomic Energy Agency, Vienna (Austria). Jan 1993. (CONF-8906428–: Advisory group meeting on development and evaluation of alternative radioanalytical methods, including mass spectrometry for marine materials, Monaco (Monaco), 6-9 Jun 1989). In *Development and evaluation of alternative radioanalytical methods, including mass spectrometry for marine materials: Proceedings of an advisory group meeting held in Monaco, 6-9 June 1989.* [95p.] Order Number DE93625117. Source: OSTI; NTIS (US Sales Only); INIS.

The chapter aims primarily to provide a reference with which the various mass spectrometric methods may be compared. The fundamental problems created by low specific activity in the measurement of very long-lived radionuclides using radiometric techniques are noted and discussed in terms of the different types of decay, background count rates, source weight and spectral interferences. An attempt is made to identify typical detection limits for the radiometric determination of the various long-lived radionuclides. The use of neutron activation as a means of enhancing sensitivity or convenience of measurement for long-lived radionuclides is described with appropriate illustrations. Mass spectrometry and radiometry are seen as complementary, not competitive techniques for the measurement of radioactive materials, each with its own advantages and disadvantages. (author). 21 refs, 2 figs, 6 tabs.

24073 (IAEA-TECDOC–683, pp. 25-35) **Accelerator mass spectrometry.** Mangini, A. (Heidelberger Akademie der Wissenschaften, Heidelberg (Germany)). International Atomic Energy Agency, Vienna (Austria). Jan 1993. (CONF-8906428–: Advisory group meeting on development and evaluation of alternative radioanalytical methods, including mass spectrometry for marine materials, Monaco (Monaco), 6-9 Jun 1989). In *Development and evaluation of alternative radioanalytical methods, including mass spectrometry for marine materials: Proceedings of an advisory group meeting held in Monaco, 6-9 June 1989.* [95p.] Order Number DE93625117. Source: OSTI; NTIS (US Sales Only); INIS.

The advances in Accelerator Mass Spectrometry (AMS) during the last 5 to 10 years enable the measurement of cosmogenic radionuclides such as ^{10}Be, ^{36}Cl, ^{26}Al, ^{14}C, ^{7}Be, and ^{32}Si, to a sensitivity exceeding the conventional detection methods via counting of radioactive decay. These new techniques enable the application of these nuclides to problems in the fields of marine geochemistry, geology and hydrology. (author). 18 refs, 3 figs, 2 tabs.

24074 (IAEA-TECDOC–683, pp. 45-51) **Thermal ionization mass spectrometry.** Buesseler, K.O. (Woods Hole Oceanographic Inst., Woods Hole, MA (United States)). International Atomic Energy Agency, Vienna (Austria). Jan 1993. (CONF-8906428–: Advisory group meeting on development and evaluation of alternative radioanalytical methods, including mass spectrometry for marine materials, Monaco (Monaco), 6-9 Jun 1989). In *Development and evaluation of alternative radioanalytical methods, including mass spectrometry for marine materials: Proceedings of an advisory group meeting held in Monaco, 6-9 June 1989.* [95p.] Order Number DE93625117. Source: OSTI; NTIS (US Sales Only); INIS.

Thermal ionization mass spectrometry (TIMS, or also known as surface ionization MS) refers to a technique for producing ions at the source of the mass spectrometer by evaporating a sample from a heated metal surface. This technique has been successfully employed for a large number of elements to measure precise isotopic ratios in a wide variety of environmental samples. By adding a known quality of an appropriate yield tracer to the sample, isotope dilution analyses can provide for concentration determinations down to the 10^{-15} to 10^{-18} gram range, using TIMS instruments. The background discussion on TIMS presented below, is intended to provide a brief overview of important considerations in TIMS techniques and instruments, and is based primarily upon the use of TIMS for the determination of long-lived actinides such as U, Th and Pu. (author). 42 refs.

24075 (IAEA-TECDOC–683, pp. 53-63) **Resonance ionization mass spectrometry.** Baxter, M.S. (International Atomic Energy Agency, Monaco (Monaco). Marine Environment Lab.). International Atomic Energy Agency, Vienna (Austria). Jan 1993. (CONF-8906428–: Advisory group meeting on development and evaluation of alternative radioanalytical methods, including mass spectrometry for marine materials, Monaco (Monaco), 6-9 Jun 1989). In *Development and evaluation of alternative radioanalytical methods, including mass spectrometry for marine materials: Proceedings of an advisory group meeting held in Monaco, 6-9 June 1989.* [95p.] Order Number DE93625117. Source: OSTI; NTIS (US Sales Only); INIS.

Of the various techniques outlined in this volume, that of resonance ionization mass spectrometry (RIMS) is until now the least developed yet it has perhaps the greatest potential for ultra-high-sensitivity nuclide-specific measurements. This statement applies generally and not only in the marine radioactivity context. There have thus far been no reported marine studies by RIMS on any of the radionuclides of interest listed in Appendix I - hence the absence of a RIMS entry in the summary tables. Yet the potential is considerable because, in RIMS, lasers effectively carry out a significant part of the chemistry which the other mass-spectrometric methods pre-require in stringent form; thus RIMS has added potential to reduce time, effort, isobaric and molecular interferences and hence to increase detection limits. (author). 27 refs, 4 figs.

24076 (IAEA-TECDOC–690, pp. 304-308) **Quantitative analysis of trace amounts of impurities contaminating pure graphite with ICP-MS and metal atomizer FLAAS.** Miyatani, T. (Toyo Tanso Co., Ltd, Mitoyo, Kagawa (Japan)); Suzuki, H.; Yoshimoto, O. International Atomic Energy Agency, Vienna (Austria). Feb 1993. (CONF-9109266–: International Atomic Energy Agency (IAEA) specialists meeting on status of graphite development for gas-cooled reactors, Tokai (Japan), 9-12 Sep 1991). In *The status of graphite development for gas cooled reactors: Proceedings of a specialists'*

meeting held in Tokai, Japan, 9-12 September 1991. [311p.] Order Number DE93625195. Source: OSTI; NTIS (US Sales Only); INIS.

Graphite has excellent properties for the moderator or reflector of the high temperature gas-cooled reactor. In semi-conductor engineering, graphite is also available widely. For these applications the determination of the extremely low impurity level for graphite is one of the most important problems. Using an inductive coupled plasma mass spectrometer, the impurity level of elements Li, B, Na, Mg, Al, Ti, V, Cr, Fe, Mn, Ni, Co, and Zn were analyzed. Using a metal atomizer-flameless atomic absorption spectrophotometer the impurity level of K, Ca and Cu were analyzed. The highly purified graphite (IG-110) manufactured by Toyo Tanso was used for the sample. It was found that the quantitative analysis of a trace amount of impurities in graphite with high sensitivity is possible with these analyzing methods. (author). 11 figs, 1 tab.

24077 (IEN-DQUI-DIAPQ–001/86) **Spectrophotometric determination of beryllium.** Dutra, P.B. Instituto de Engenharia Nuclear (IEN), Rio de Janeiro, RJ (Brazil). Div. de Quimica. 1986. [7p.] (In Portuguese). Order Number DE93624294. Source: OSTI; NTIS (US Sales Only); INIS.

The studies of beryllium analysis in ores or in its industrial compounds are presented, including its purification, extraction with mesityl oxide and spectrophotometry. (C.G.C.).

24078 (IEN-DQUI-DISIS–001/86) **Potentiometric titration of uranium reduced by chromic salts in chloridic solutions.** Coutinho, C.M.C.; Bastos, E.T.R. Instituto de Engenharia Nuclear (IEN), Rio de Janeiro, RJ (Brazil). Div. de Quimica. Jun 1986. [4p.] (In Portuguese). Order Number DE93624295. Source: OSTI; NTIS (US Sales Only); INIS.

The utilization of chromic salts for reducing the uranium (VI) from chloridic solutions, for potentiometric dosage is described. This method is used in the range of 0,002 to 1,0 M of uranium. (C.G.C.).

24079 (IEN-DQUI-DISIS–002/86) **Uranium determination by spectrophotometry, in chloride solutions, using titanium (III) as reducer.** Bastos, E.T.R.; Bastos, M.B.R. Instituto de Engenharia Nuclear (IEN), Rio de Janeiro, RJ (Brazil). Div. de Quimica. Aug 1986. [6p.] (In Portuguese). Order Number DE93624296. Source: OSTI; NTIS (US Sales Only); INIS.

A simple method for determining uranium in uranium (VI) solutions with the presence of uranium (IV), iron (II), and titanium (IV) in chloridic solution is described. The method comprises in uranium (VI) reduction with titanium (III), acidity adjustment and uranium (IV) spectrophotometry in hydrochloric acid 2 M. (C.G.C.).

24080 (JINR-E–14-91-398) **Fine-powder Al_2O_3 and SiO_2 for preparation of multielement standards for rare-earth elements analysis.** Nazarov, V.M.; Chinaeva, V.P.; Frontasyeva, M.V.; Parry, S.; Bennet, B.A.; Chen Sen Pal; Li Chel Zu. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of Nuclear Problems. 1991. [8p.] Order Number DE93625118. Source: OSTI; NTIS (US Sales Only); INIS.

The present paper based on the experimental results contains the discussions and suggestions on the possible use of the fine-powder Al_2O_3 and SiO_2 as multielement standards for neutron activation analysis with original content of microimpurities up to 40 elements. 3 refs.; 1 fig.; 3 tabs.

24081 (LA–12436-MS-Vol.1) **Quality assurance for environmental chemistry, 1991: Volume 1.** Gautier, M.A.; Gladney, E.S.; Jones, E.A.; Koski, N.L.; O'Malley, B.T.; Brooks, G.H.; Moss, W.D. Los Alamos National Lab., NM (United States). Dec 1992. 149p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. Order Number DE93011791. Source: OSTI; NTIS; GPO Dep.

This report documents the continuing quality assurance efforts of the Environmental Chemistry Group (EM-9) at the Los Alamos National Laboratory. The philosophy, methodology, computing resources, and laboratory Information management system used by the quality assurance program to encompass the diversity of analytical chemistry practiced in the group are described. Included in the report are all quality assurance reference materials used, along with their certified or consensus concentrations, and all analytical chemistry quality assurance measurements made by EM-9 during 1991.

24082 (LA–12436-MS-Vol.2) **Quality assurance for environmental chemistry, 1991: Volume 2.** Gautier, M.A.; Gladney, E.S.; Jones, E.A.; Koski, N.L.; O'Malley, B.T.; Brooks, G.H.; Moss, W.D. Los Alamos National Lab., NM (United States). Dec 1992. 473p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. Order Number DE93011792. Source: OSTI; NTIS; GPO Dep.

This report documents the continuing quality assurance efforts of the Environmental Chemistry Group (EM-9) at the Los Alamos National Laboratory. The philosophy, methodology, computing resources, and laboratory Information management system used by the quality assurance program to encompass the diversity of analytical chemistry practiced in the group are described. Included in the report are all quality assurance reference materials used, along with their certified or consensus concentrations, and all analytical chemistry quality. assurance measurements made by EM-9 during 1991. This volume contain figures and tables related to analytical results and the computer software QA CHECK.

24083 (LA-SUB–93-171) **Synthesis of organic ligands for f-element separations: Final report.** Paine, R.T. (New Mexico Univ., Albuquerque, NM (United States). Dept. of Chemistry). Los Alamos National Lab., NM (United States); New Mexico Univ., Albuquerque, NM (United States). Dept. of Chemistry. [1993]. 61p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. Order Number DE93012915. Source: OSTI; NTIS; GPO Dep.

The efficacy of CMP and CMPO (carbamoylmethylphosphonates, carbamoylmethylphosphine oxides) as extractants has stimulated interest in design of new extractants, in particular, bifunctional and trifunctional ligands containing both P=O and N-O donors. 2,6-bis(diphenylphosphino)pyridine N,P,P-trioxide was selected as a target, with the bifunctional and trifunctional diphenylmethylphosphino analogs as alternate target ligands. The ligands were synthesized and characterized. Their coordination chemistry was studied using Pr, Tb, Yb, Th; a wider range of metal/ligand stoichiometries was found than typically found for other ligands, and the ligands are sufficiently basic that, under some conditions, they displace nitrate ion from the inner coordination sphere, which is unusual for neutral donor ligands. For both 2:1 and 4:1 complexes, the ligand is bonded to the Ln(III) ions in a bidentate manner, and in a tridentate manner for 1:1 and 2:1 complexes. These ligands may be unusually effective solvent extraction agents, and liquid-liquid extraction studies are in progress. (DLC)

24084 (LBL–33753) **The effect of crystal tilt on high resolution micrographs of small metal particles.** Malm, J.O. (Lund Univ. (Sweden). Dept. of Inorganic Chemistry 2); O'Keefe, M.A. Lawrence Berkeley Lab., CA (United States). Jan 1993. 2p. Sponsored by USDOE, Washington, DC (United States); Swedish National Science Research Council (Sweden). DOE Contract AC03-76SF00098. Grant K-KU 6332-303. (CONF-9306164–1: Conference on electron microscopy, Lund (Sweden), 9-11 Jun 1993). Order Number DE93013915. Source: OSTI; NTIS; GPO Dep.

The structure of small (1.5-5 nm) metal particles has been studied by high resolution transmission electron microscopy. For particles of this size, it is not possible to use tilting techniques (selected area diffraction), which means that the microscopist has to rely on the image when deciding in which direction the particle is viewed. This work points out some of the problems of intuitive determination of the viewing direction. (DLC)

24085 (ORNL/FTR–4205) **[Travel to Australia for meetings on materials science and electron microscopy]: Foreign trip report, February 5–22, 1992.** Bentley, J. Oak Ridge National Lab., TN (United States). 9 Mar 1992. 18p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93010574. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Invited papers were presented at the Australian Conference on Electron Microscopy (ACEM-12) and at two workshops on analytical electron microscopy. Invited seminars were presented at

ANSTO, Lucas Heights Research Laboratories, and CSIRO, Division of Materials Science and Technology. The conference, workshops, and laboratory visits afforded a comprehensive overview of Australian electron microscopy research and applications to materials science.

24086 Programmable spectral imaging method and apparatus. Buican, T.N.; Yoshida, T.M. To Dept. of Energy. 1991. Filed date 30 Apr 1991. USA patent application 7-693,466. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. Order Number DE93012012. Source: OSTI; NTIS; GPO Dep.

This invention is comprised of an integrated fluorescence analysis system that enables a component part of a sample to be virtually sorted within a sample volume after a spectrum of the component part has been identified from a fluorescence spectrum of the entire sample in. a flow cytometer. Birefringent optics enables the entire spectrum to be resolved into a set of numbers representing the intensity of spectral components of the spectrum. One or more spectral components are selected to program a scanning laser microscope, preferably a confocal microscope, whereby the spectrum from individual pixels or voxels in the sample can be compared. Individual pixels or voxels containing the selected spectral components are identified and an image may be formed to show the morphology of the sample with respect to only those components having the selected spectral components. There is no need for any physical sorting of the sample components to obtain the morphological information.

24087 (SAND–93-0813C) **Crystallographic phase identification in the scanning electron microscope: Backscattered electron Kikuchi patterns.** Michael, J.R.; Goehner, R.P. Sandia National Labs., Albuquerque, NM (United States). [1993]. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-930822–2: Annual meeting of the Electron Microscopy Society of America, Cincinnati, OH (United States), 1-6 Aug 1993). Order Number DE93011574. Source: OSTI; NTIS; INIS; GPO Dep.

Use of charge coupled device-based detector for acquisition of high-quality backscattered electron Kikuchi patterns (BEKP) allows on-line crystallographic phase identification in the SEM. Phase identification through combined BEKP and energy dispersive x-ray spectrometry is demonstrated using Ru oxide thin films on Si, which were identified as tetragonal RuO_2. (DLC)

24088 (SLAC–415) **Proceedings of the workshop on applications of synchrotron radiation to trace impurity analysis for advanced silicon processing.** Laderman, S. (Integrated Circuits Business Div., Hewlett Packard Co., Palo Alto, CA (United States)); Pianetta, P. Stanford Linear Accelerator Center, Menlo Park, CA (United States). Mar 1993. 159p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00515. (SLAC/SSRL–0009;CONF-9210277–: Workshop on the applications of synchrotron radiation to trace impurity analysis of advanced silicon processing, Stanford, CA (United States), 21 Oct 1992). Order Number DE93013389. Source: OSTI; NTIS; GPO Dep.

Wafer surface trace impurity analysis is essential for development of competitive Si circuit technologies. Today's grazing incidence x-ray fluorescence techniques with rotating anodes fall short of requirements for the future. Hewlett Packard/Toshiba experiments indicate that with second generation synchrotron sources such as SSRL, the techniques can be extended sufficiently to meet important needs of the leading edge Si circuit industry through nearly all of the 1990's. This workshop was held to identify people interested in use of synchrotron radiation-based methods and to document needs and concerns for further development. Viewgraphs are included for the following presentations: microcontamination needs in silicon technology (M. Liehr), analytical methods for wafer surface contamination (A. Schimazaki), trace impurity analysis of liquid drops using synchrotron radiation (D. Wherry), TRXRF using synchrotron sources (S. Laderman), potential role of synchrotron radiation TRXRF in Si process R&D (M. Scott), potenital development of synchrotron radiation facilities (S. Brennan), and identification of goals, needs and concerns (M. Garner).

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Refer also to citation(s) 22655, 22659, 22796, 22797, 22830, 22855, 22857, 22924, 23732, 23831, 23958, 24033, 24083, 24123, 24124, 24125, 24126, 24127, 24518, 24823

24089 (ANL/MSD/CP–77829) **Dialkylimidazolium chloroaluminates: Ab initio calculations, Raman and neutron scattering measurements.** Takahasi, S. (Nisshin Steel Co. Ltd., Tokyo (Japan)); Curtiss, L.A.; Gosztola, D.; Koura, N.; Loong, C.K.; Saboungi, M.L. Argonne National Lab., IL (United States). Materials Science Div. Apr 1993. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-930571–11: 183. Electrochemical Society meeting, Honolulu, HI (United States), 16-21 May 1993). Order Number DE93012941. Source: OSTI; NTIS; GPO Dep.

The Raman and neutron scattering spectra of 46 mol% $AlCl_3$ -54 mol% 1-ethyl-3-methyl imidazolium chloride (EMIC) and 67 mol% $AlCl_3$ - 33 mol% EMIC melts are presented. Ab initio molecular orbital calculations have been carried out on structures of chloroaluminate anion and EMI cation and the interaction between anion and cation.

24090 (BNL–48645) **Symmetry lowering in crystalline solid solutions: A study of cinnamamide-thienylacrylamide by x-ray and neutron diffraction and solid-state photochemistry.** Shimon, L.J.W. (Brookhaven National Lab., Upton, NY (United States)); Weissinger-Lewin, Y.; McMullan, R.K.; Vaida, M.; Frolow, F.; Lahav, M.; Leiserowitz, L. Brookhaven National Lab., Upton, NY (United States). [1993]. 48p. Sponsored by USDOE, Washington, DC (United States); United States-Israel Binational Science Foundation, Jerusalem (Israel). DOE Contract AC02-76CH00016. (CONF-9304113–1: Faraday Division of Royal Society of Chemistry conference on crystal growth, Glasgow (United Kingdom), 14-16 Apr 1993). Order Number DE93010871. Source: OSTI; NTIS; GPO Dep.

Principles are outlined for symmetry lowering of a mixed crystal. A survey is given of methods used to detect reduced symmetry: changes in crystal morphology, detection of enantiomeric segregation of chiral additives in "centrosymmetric" crystals, generation of second harmonic optical signals, optical birefringence, asymmetric photoreactions in the crystalline state and X-ray and neutron diffraction. The last two methods are applied to mixed crystals of cinnamamide host and thienylacrylamide. Diffraction demonstrated that the mixed crystals are composed of six sectors of reduced symmetry, from monoclinic centrosymmetric $P2_1/c$ to triclinic P1 in four sectors and possibly Pc in the remaining two. The X-ray diffraction data were not sufficiently accurate for assigning the absolute structures of the PI sectors of anomalous X-ray scattering. Thus, by this method one could not ascertain the absolute orientation of the guest molecules on the surface sites through which they were selectively occluded. This ambiguity was resolved by assignment of the absolute configuration of the chiral heterophotodimers, between host and guest, in enantiomeric excess in the PI sectors, after irradiation with UV light. This leads to the conclusion that the selective occlusion of thienylacrylamide arises from replacement of attractive C-Hπ (electron) interactions between host molecules by a repulsive sulfur (lone pair electron)π(electron) interactions between guest and host at the crystal surfaces.

24091 (CEA-CONF–11282) **Thermal stability of morpholine, AMP and sarcosine in PWR secondary systems. Laboratory and loop experiments.** Feron, D.; Lambert, I. CEA Centre d'Etudes de Fontenay-aux-Roses, 92 (France). Service de la Corrosion, d'Electrochimie et Chimie des Fluides. 1991. [21p.] (CONF-9108114–: 2. international symposium on chemistry in high temperature water, Provo, UT (United States), 19-22 Aug 1991). Order Number DE93626262. Source: OSTI; NTIS (US Sales Only); INIS.

Laboratory and loop tests have been carried out in order to investigate the thermal stability of three amines (morpholine, AMP and sarcosine) in PWR secondary conditions. Laboratory experiments have been performed in a titanium autoclave at 300 deg C. The results pointed out high thermal decomposition rates of AMP and sarcosine. A decomposition mechanism is proposed for the 3 amines. Loop tests have been performed in order to compare

steam cycle conditioning with ammonia, morpholine and AMP. The amine concentrations and the decomposition products such as acetate and formate have been followed around the secondary circuit of the ORION loop which reproduces the main physico-chemical characteristics of a PWR secondary circuit. These concentrations are reported together with the evolution of cationic conductivities. The influence of oxygen concentration on amine thermal stability has been observed. Results are expressed also in terms of decomposition rates and of relative volatility.

24092 (CONF-921275–, pp. 7-10) **Application of the environmental temperature oscillation method to a continuous tank type reactor. 2.: Monitoring the reaction run-away starting temperature using transient response measurement.** Nagai, T. (Yokohama National University, Yokohama (Japan)); Ishihara, a.; Asakura, S. 2 Dec 1992. 160p. (In Japanese). From 25. safety engineering study meeting; Kitakyushu (Japan); 2-3 Dec 1992. In *Proceedings of the 25th Safety Engineering Study Meeting.* Order Number DE93793904. Source: OSTI; NTIS (US Sales Only).

Discussions were given on a method to predict reaction runaway risks in a heat generating chemical reaction process. A critical temperature at which a system loses stability can be derived from the stability index μ. Stability is indicated by $\mu>0$, a critical condition by $\mu=0$,and instability by $\mu<0$. The index μ is derived by measuring temperature response Δ Ts in a system against an oscillation Δ Te in the environmental temperature, while measuring Δ Ts requires a long time before the system reaches a new steady state. Accordingly, a method to use transient response was proposed in this paper. Using a reaction heat balance in a continuous tank type reactor against the time functions Δ Te (t) and Δ Ts (t), a linear locus was obtained on the time constants (taw) and μ. By giving an oscillation of an adequate time function Δ Te (t) to a system in steady condition, and measuring Δ Ts (t) in the system, (taw) and μ can be derived quickly from the obtained locus. By plotting several (Ts, μ)s from an experiment, extrapolating them, and finding a cross section with a curve for $\mu=0$, the critical temperature can be provided. The method was applied to a methanol reaction using Fenton's reagent, where a good prediction value was obtained. 1 ref., 7 figs., 1 tab.

24093 (CONF-921275–, pp. 29-30) **Considerations on thermal stability evaluation. 4.** Fujita, A. (Mitsubishi Kasei Corp., Tokyo (Japan)); Akiba, K.; Iizuda, Y. 2 Dec 1992. 160p. (In Japanese). From 25. safety engineering study meeting; Kitakyushu (Japan); 2-3 Dec 1992. In *Proceedings of the 25th Safety Engineering Study Meeting.* Order Number DE93793904. Source: OSTI; NTIS (US Sales Only).

Using data from tests of a laboratory scale as basic data for a process design presents a problem in reliability of the test data. This paper discusses reliability of an isothermal retention test using an accelerating rate calorimeter (ARC) known as a heat insulation testing equipment. The test sample used was dicyclohexyl phthalate (DCP) containing BPO at 22.5% by weight and DCP at 77.5% by weight. The sample was determined of heat generation at 0.02°C /min when retained isothermally at 55°C. Because maintaining the test accuracy requires a calibrating operation on thermocouples, the first and eighth measurements were compared after calibration. As a result of investigating other effects of sample amount, it was believed that using the ARC isothermal retention data simply to predict time-based changes in a practical facility scale would present problems which require discussions according to specificities of reaction systems. 5 figs.

24094 (CONF-921275–, pp. 31-32) **Considerations on thermal stability evaluation. 5.: Evaluation on thermal decomposability of azobenzene using DSC.** Iizuka, Y. (Mitsubishi Kasei Corp., Tokyo (Japan)); Fujita, A.; Akiba, K. 2 Dec 1992. 160p. (In Japanese). From 25. safety engineering study meeting; Kitakyushu (Japan); 2-3 Dec 1992. In *Proceedings of the 25th Safety Engineering Study Meeting.* Order Number DE93793904. Source: OSTI; NTIS (US Sales Only).

The studies on thermal decomposition behavior of azobenzene in a sealed container as having been reported in the previous reports estimated that relation between sample amount and DSC heat generation and the heat absorbing phenomenon immediately before a heat generating phenomenon are attributed to thermal characteristics of azo compounds. The present paper describes a detailed investigation on the heat generating and absorbing phenomena during an SC-DSC test in which the sample filling rate (test sample amount divided by DSC container capacity) was varied. Silver-made sealed DSC sample containers with two types of capacities were used: 15μL and 70μL. The sample temperature was raised in a velocity range from 1 to 10 °C/min. As a result, the DSC thermogram showed a large difference in the heat absorbing and generating amounts even with the same amount of samples. That is, the thermal behavior of azobenzene was affected by the sample filling rate rather than from the sample amount. A thermal decomposition reaction of trans-body vapor is the major reaction in a low filling region. In a high filling region, the liquid phase governs the reaction, where the reaction transfers to isomerization of trans-bodies to cis-bodies, and to thermal decomposition of the cis-bodies. 1 ref., 3 figs., 1 tab.

24095 (DOE/ER/14065–T1) **Phase equilibria and volumetric properties for the System NaCl-$CaCl_2$-H_2O.** Oakes, C.S. Virginia Polytechnic Inst. and State Univ., Blacksburg, VA (United States). [1993]. 119p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG05-89ER14065 ;AC05-84OR21400. Order Number DE93013590. Source: OSTI; NTIS; GPO Dep.

Low temperature phase relations in the ice-stable field of the system NaCl-$CaCl_2$-H_2O were determined under 1 atm. total pressure along the NaCl-H_2O and $CaCl_2$-H_2O binaries and along five pseudobinaries with constant NaCl/(NaCl+$CaCl_2$) weight ratios. The results are in excellent agreement with published data along the NaCl-H_2O binary but show large discrepancies when compared to previous determinations of the ice liquidus alone, the $CaCl_2$-H_2O binary and in the NaCl-$CaCl_2$-H_2O ternary. At moderate to high salinities, isotherms cross the ice sub-field at lower total salt concentrations than previously reported. In addition, NaCl(NaCl+$CaCl_2$) weight ratios estimated from hydrohalite- and ice-melting temperatures may be low by as much as 15%. Relative densities were measured for NaCl(aq) and $CaCl_2$(aq) solutions to 250°C and 400 bars and over the range of ionic strengths 0.2–5.5 and 0.2–19.2 mol·kg^{-1}, respectively. The results span the pressure and temperature of earlier volumetric studies and extend to higher molalities than reported previously. The relative densities have been fitted as apparent molar volumes (V_ϕ) using the Pitzer ion-interaction treatment, with appropriate expressions chosen for the temperature- and pressure-dependence of the virial coefficients of the model. The results presented for NaCl(aq) are in good agreement with published results to 250°C. The results presented for $CaCl_2$(aq) are in good agreement with published values to approximately 125°C.

24096 (DOE/ER/14280–1) **Catalytic arene hydrogenation using early transition metal hydride compounds: Progress report.** Rothwell, I.P. Purdue Univ., Lafayette, IN (United States). 15 Mar 1993. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-92ER14280. Order Number DE93015500. Source: OSTI; NTIS; GPO Dep.

Progress was achieved in four areas: development of surface supported Group 5 metal organometallic compounds for catalytic arene hydrogenation, isolation and reactivity of possible intermediates in catalytic arene hydrogenation, synthesis and characterization of new d^0-metal hydride compounds, and stoichiometric reactivity of d^0 metal hydrido, aryloxide compounds. (DLC)

24097 (DOE/ER/14281–1) **Anchoring strategies for bimetallic species in zeolites: Progress report.** Bein, T. Purdue Univ., Lafayette, IN (United States). Dept. of Chemistry. Mar 1993. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-92ER14281. Order Number DE93015622. Source: OSTI; NTIS; GPO Dep.

We explore a new approach by introducing heterobinuclear organometallic compounds for linking catalytic functions to zeolite frameworks. With two different metals present, the complexes are being anchored to the support via one oxophilic metal, ligand exchange and catalytic reactions may proceed at the second metal center. Anchoring chemistry, thermal stability and reactivity of $Me_3SnMn(CO)_5$ in zeolite NaY and acid forms of zeolite Y was studied with X-ray absorption spectroscopy (Sn, Mn edge EXAFS) and in-situ FTIR/TPD-MS techniques. Subsequently, the tin-cobalt complex $Me_3SnCo(CO)_4$ has been a focus of detailed synthetic

and spectroscopic studies. The reactivity of tricarbonyl (cyclopentadienyl) (trimethylstannyl) molybdenum in new mesoporous hosts has been explored. A recent development is the design of vanadium oxo species in different micro- and mesoporous hosts. These are of great interest for the selective reduction of nitrogen oxides by ammonia, and selective oxidation of different hydrocarbons, such as xylenes, olefines and alkanes. Combination analytical techniques used to probe local structural changes at the molecular level, include EXAFS (Extended X-Ray Absorption Fine Structure) spectroscopy utilizing synchrotron radiation, in situ FT-IR coupled to thermodesorption/MS, UV-NIR, and CCD Raman.

24098 (DOE/ER/14289–1) **An investigation of molybdenum and molybdenum oxide catalyzed hydrocarbon formation reactions: Progress report, August 1, 1992–April 1, 1993.** Wisconsin Univ., Milwaukee, WI (United States). 1993. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-92ER14289. Order Number DE93015932. Source: OSTI; NTIS; GPO Dep.

Progress was made in the following four areas: activity of model catalyst (Mo oxides) for olefin metathesis (2 $C_3H_6 \rightarrow C_4H_8 + C_2H_4$); kinetics of Mo(100)-catalyzed olefin metathesis; surface chemistry of ethylene oxide on Pd(111); and uv source construction.

24099 (DOE/ER/14301–1) **Photoinduced charge separation in linked donor-chromophore-acceptor systems: Progress report, September 1, 1993–May 31, 1993.** Elliott, C.M. Colorado State Univ., Fort Collins, CO (United States). Jun 1993. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-92ER14301. Order Number DE93015070. Source: OSTI; NTIS; GPO Dep.

Focus has been mainly on preparation and characterization of triply bridged dinuclear complexes containing a tris-2-2'-bipyridineruthenium chromophore and a second tris-bipyridine metal complex which is to serve as electron donor or acceptor, and of linked RuL_3-containing D-C-A complexes where D is a phenothiazine donor and A is a diquat type acceptor. (DLC)

24100 (DOE/PC/89784–T2) **Binding and catalytic reduction of NO by transition metal aluminosilicates: Final technical progress report, September 1989–August 1992.** Klier, K.; Herman, R.G.; Hou, S. Lehigh Univ., Bethlehem, PA (United States). Feb 1993. 109p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-89PC89784. Order Number DE93014856. Source: OSTI; NTIS; GPO Dep.

Catalysts prepared and analyzed include cobalt(II) exchanged A zeolites having 1.3, 1.77, 2.6, and 3.9 Co(II) ions per unit cell. They have been analyzed by high resolution X-ray photoelectron spectroscopy (HR-XPS) and optical diffuse reflectance spectroscopy before and after dehydration and after adsorption and desorption of NO. The ion exchange process can be quantitatively monitored by HR-XPS analysis. The reactor system, with a quadrupole mass spectrometer for gas analysis, allows in situ optical spectroscopy by diffuse reflectance to be carried out to determine the oxidation state and symmetry of the transition metal ions prior to and after interaction with NO and with N_2O. Both static and dynamic temperature programmed reaction and desorption (TPD) experiment were carried out. Adsorption experiments confirmed accessibility of trigonally held transition metal cations and that NO adsorption is strong and reversible. A doubly exchanged Co/Ce A zeolite was prepared, characterized, and tested for NO decomposition. This catalyst was especially active for NO decomposition, but segregation of the Ce component tended to occur. The Ce-containing zeolites tended to form N_2O in larger amount than N_2 under the TPD conditions that were utilized. An understanding of the electronic structure and bonding scheme in the zeolite-held complexes was provided by semi-empirical extended Hueckel calculations. Ligand field stabilization energies were calculated for the first row transition series monovalent and divalent metals, as were the reducibilities. The transition metal cations on the right side of the periodic table should form strong complexes with NO. Valence band spectra, as well as HMO calculations, indicate that there is significant bonding overlap of 3d orbitals of Co ions with the zeolite O 2p-based lattice orbitals.

24101 (DOE/PC/90035–T2) **Synthesis of 6-Methyl-9-propyldibenzothiophene-4-ol: Technical progress report No. 2, October 25, 1990–January 25, 1991.** Eisenbraun, E.J. Oklahoma State Univ., Stillwater, OK (United States). Dept. of Chemistry. 15 Feb 1991. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-90PC90035. Order Number DE93015779. Source: OSTI; NTIS; GPO Dep.

The synthesis route for preparing the title compound, has been carried out on a small scale for the preparation of a mixture of isomers. Alternative routes for the cyclization are being explored. (DLC)

24102 (DOE/PC/90035–T6) **Synthesis of 6-Methyl-9-n-propyldibenzothiophene-4-ol ammended to 6-Methyl-9-(1-methylethyl)-dibenzothiophene-4-ol: Quarterly technical progress report No. 6, October 28, 1991–January 26, 1992.** Oklahoma State Univ., Stillwater, OK (United States). 28 Feb 1992. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-90PC90035. Order Number DE93015775. Source: OSTI; NTIS; GPO Dep.

The material presented below is taken from Status Reports 15, 16 and 17 and covers the progress made toward the synthesis of the modified target molecules 9-isopropyl-4-methoxy-6 methyldibenzothiophene (13) and 9-isopropyl-6methyldibenzothiophene-4-ol (14).

24103 (DOE/PC/91306–6) **Sorption and chemical transformation of PAHs on coal fly ash: Technical progress report No. 6.** Mamantov, G.; Wehry, E.L. Tennessee Univ., Knoxville, TN (United States). Dept. of Chemistry. [1993]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-91PC91306. Order Number DE93014974. Source: OSTI; NTIS; GPO Dep.

The objective of this work is to characterize the interactions of coal fly ash with polycyclic aromatic hydrocarbons (PAHs) and their derivatives, and to understand the influence of the surface properties of coal ash (and other atmospheric particles) on the chemical transformations of polycyclic aromatic compounds. Specific investigations directed toward this overall objective include: (a) Fractionation of heterogeneous coal fly ash samples into different particle types varying in size and chemical composition (carbonaceous, mineralmagnetic, and mineral nonmagnetic); (b) Measurement of the rates of chemical transformation of PAHs and PAH derivatives (especially nitro-PAHs) and the manner in which the rates of such processes are influenced by the chemical and physical properties of coal fly ash particles; (c) Chromatographic and spectroscopic studies of the nature of the interactions of coal fly ash particles with PAHs and PAH derivatives; (d) Characterization of the fractal nature of fly ash particles (via surface area measurements) and the relationships of "surface roughness" of fly ash particles to the chemical behavior of PAHs sorbed on coal ash particles. PAHs are deposited, under controlled laboratory conditions, onto coal ash surfaces from the vapor phase, in order to mimic the processes by which PAHs are deposited onto particulate matter in the atmosphere.

24104 (DOE/PC/92118–T1) **Bench-scale demonstration of biological production of ethanol from coal synthesis gas: Quarterly report, September 24, 1992–December 31, 1992.** Engineering Resources, Inc., Fayetteville, AR (United States). 1992. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-92PC92118. Order Number DE93015055. Source: OSTI; NTIS; GPO Dep.

Culture isolation and selection studies are being performed in order to select the best biological system for bench-scale studies in producing ethanol from syngas components. Three isolates have been found which produce more than 2 g/L ethanol from CO and $C0_2/H_2$ in batch culture. These low concentrations are actually quite promising since Clostridium ljungdahlii, strain PETC, performs well in continuous culture but produces only small concentrations of ethanol in batch culture after several weeks of incubation. Two of the isolates have been utilized in the CSTR, where 90 percent CO conversions have been noted, while producing up to 2 g/L ethanol, in preliminary studies. CSTR studies will continue until steady state is reached. An anaerobic bacterium has been isolated from natural sources that converts the components of synthesis

gas (CO, H_2,$C0_2$) into ethanol. This organism, the only one known at that time to produce ethanol from synthesis gas, has been identified as a new clostridial strain and has been named Clostridium ljungdahlii, strain PETC.

24105 (DOE/PC/92521–T29) **Protocols for the selective cleavage of carbon-sulfur bonds in coal: Technical report, December 1, 1992–February 28, 1993.** Bausch, M. (Southern Illinois Univ., Carbondale, IL (United States)); Ho, K.K. Illinois Dept. of Energy and Natural Resources, Springfield, IL (United States). [1993]. 18p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC22-92PC92521. Order Number DE93013648. Source: OSTI; NTIS; GPO Dep.

Chemical reactions that result in carbon-sulfur bond cleavage are an essential aspect of any protocol designed to remove organic sulfur from coal. Planned in the second year of our project Protocols for the Selective Cleavage of Carbon-Sulfur Bonds in Coal are investigations of reactions in which organic sulfur-containing coal model compounds are subjected to different conditions of temperature, solvent mixtures and radiation. Other investigations that will result in analyses of the likelihood of C-S bond cleavages resulting from various oxidative processes will also be undertaken. Summarized in this quarterly report are results of our investigations of the following topics: (a) desulfurization of coal model sulfones; (b) desulfurization of coal model sulfides; (c) photooxidation of organic sulfides; and (d) photolytic desulfurization of coal.

24106 (DOE/PC/92532–T3) **Fischer-Tropsch synthesis in supercritical reaction media: Progress report, January 1, 1993–March 31, 1993.** Subramaniam, B.; Bochniak, D.; Snavely, K. Kansas Univ., Lawrence, KS (United States). Dept. of Chemical and Petroleum Engineering. Apr 1993. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-92PC92532. Order Number DE93014963. Source: OSTI; NTIS; GPO Dep.

The reactor configuration has been modified to handle tows both in the upflow and downflow directions. For comparison to bubble column operation, an upflow mode of operation will be used. For comparison to trickle-bed operation, a downflow mode will be employed. Thus, this modification allows the most flexibility for studying the effects of liquid and supercritical reaction media on the Fischer-Tropsch synthesis reaction and permits comparisons of our experimental results with previous work. A stainless steel reactor tube was ordered. This unit along with three other pieces of tubing (greater than 1/4in. i. d.) are to be sent to Alon Processing Co. for alonizing (passivating) the internal surface. This process had been employed by Huff and Satterfield (1983) to ensure that the stainless steel surfaces are catalytically inert at high temperatures (> 200°C).

24107 (INIS-CL–004) **Kinetic and thermodynamic study of lithium ternary amalgams in contact with solvated lithium hydroxide.** Cordova M, M. Chile Univ., Santiago (Chile). Facultad de Ciencias. Dec 1991. [130p.] (In Spanish). Order Number DE93625290. Source: OSTI; NTIS (US Sales Only); INIS.

Lithium amalgams are used on lithium isotope separation, the process has been studied in its different parameters, but there is no information on the isotopic separation in the presence of ternary metals diluted in the amalgam. The latest voltammetric technique developed for trace analysis is used for the study, to determine the effects of the presence of cadmium, which has been selected on compatibility criteria with the system, in the intermetallic structures of the amalgam. The differential pulse anodic stripping voltammetry indicates the presence of an intermetallic persistent structure after the potassium and lithium oxidation. This structure has a slow formation and destruction rate, with an anionic character, which accounts for the oxidation potential displacement of the amalgamated metals. The activation energy results of amalgam decomposition reaction in contact with water, allows to establish the intermetallic effects on this reaction, raising the energy of the activated state, on condition that there were time to form it. A reaction mechanism is proposed that agrees with these results. The study of the isotopic composition indicates that the intermetallic species affect the thermodynamic equilibrium between the phases in contact. The measurements of the system's isotopic composition do not give exact values for the separation factors, but they establish a difference in the sign of enthalpies of the isotopic equilibria. The enthalpy for the isotopic exchange for the binary amalgam is negative, with a value that agrees with those in the literature. Nevertheless, those of the ternary systems are positive, indicating an endothermic character process. (author).

24108 (JAERI-M–93-056) **Numerical kinetic model including equilibrium and rate equations for chemical reactions of actinide elements.** Ishiguro, Misako (Ibaraki Univ., Mito (Japan)); Tachimori, Shoichi; Naito, Shinjiro. Japan Atomic Energy Research Inst., Tokyo (Japan). Mar 1993. 35p. (In Japanese). Order Number DE93797610. Source: OSTI; NTIS; INIS.

Numerical simulation method was examined for chemical reactions of actinide elements U, Pu, Np, and Tc etc. in an aqueous nitric acid solution. It is known that the numerical calculation for the Purex process with chemical reactions and liquid flow becomes stiff, because time constant for the chemical reactions is two to three order of magnitude smaller due to the very fast reactions than that of mass transfer or of reaching distribution equilibrium. Recently in order to increase a time step Δt the partial equilibrium (P.E.) model, in which some very fast reactions are treated by the equilibrium law whereas other reactions are by the rate law, has been proposed. In the present study concentration change of the solutes in an aqueous solution with 30 chemical reactions, of which 4 are expressed by equilibrium equations, has been calculated. Description of the P.E. model and the comparison of the results and cpu time between the kinetic and the P.E. models are given. (author).

24109 (KAPL–4735) **Magnetite stability in aqueous sodium phosphate solutions at elevated temperatures.** Ziemniak, S.E.; Opalka, E.P. Knolls Atomic Power Lab., Schenectady, NY (United States). Mar 1992. 27p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC12-76SN00052. (CONF-930821–1: 9. international symposium on environmental degradation of materials in nuclear power systems, St. Louis, MO (United States), Aug 1993). Order Number DE92016359. Source: OSTI; NTIS; GPO Dep.

Magnetite (Fe_3O_4) is shown to transform to a sodium ferric hydroxy-phosphate compound in concentrated, alkaline sodium phosphate solutions at elevated temperatures via 1/3 Fe_3O_4(s) + 13/3 Na^+ + 2 $HPO_4^=$ $\rightleftarrows$ $Na_4Fe(OH)(PO_4)_2 \cdot 1/3NaOH$(s) + 1/3 H^+ + 1/6 H_2(g). The thermodynamic equilibrium for this reaction was defined in the system Na_2O-$P_2O_5$$Fe_3O_4$-$H_2O$ for Na/P molar ratios between 2.1 and 3. Quantitative chemical, infrared and Mossbauer spectroscopic, and X-ray diffraction analyses are employed to verify that the precipitated solid was a single phase having the non-whole number stoichiometric Na/P ratio 2.15 $\pm$ 0.02. Standard entropy and free energy of formation for sodium ferric hydroxyphosphate were calculated to be 729.2 J/mol-K and −3550.3 kJ/mol, respectively.

24110 (LBL–34031) **Tris(Cyclopentadienyl)Uranium-t-Butyl: Synthesis, reactions, and mechanisms.** Weydert, M. Lawrence Berkeley Lab., CA (United States). Apr 1993. 188p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. Order Number DE93015036. Source: OSTI; NTIS; GPO Dep.

Compounds $(RC_5H_4)_3U(t\text{-}Bu)$ were prepared for R = H, Me, Et. Their decomposition products in aromatic solvents are consistent with a radical decomposition pathway induced by solvent-assisted U-C bond homolysis. NMR was used to study the reactions of $(RC_5H_4)_3UCl$ with t-BuLi (R = t-Bu, Me_3Si). Reactions of $(MeC_5H_4)_3U(t\text{-}Bu)$ with Lewis bases and fluorocarbons were studied. Analogous reaction chemistry between $(RC_5H_4)_3ThX$ systems and t-BuLi was also studied, and reactivity differences between U and Th are discussed. Synthesis of sterically crowded $(RC_5H_4)_4U$ compounds is next considered. Reaction of the trivalent $(RC_5H_4)_3U$ with $(RC_5H_4)_2Hg$ results in formation of $(RC_5H_4)_4U$. Steric congestion, cyclopentadienyl ligand exchange, and electron transfer are discussed. (DLC)

24111 (ORNL/FTR–4297) **Travel to Germany and France to present two talks at the international conference on interaction of iron based materials with water and steam: Foreign trip report, May 16, 1992–June 10, 1992.** Palmer, D.A. Oak Ridge National Lab., TN (United States). 22 Jun 1992. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract

AC05-84OR21400. Order Number DE93011077. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The traveler spent two weeks at the University of Witten/ Herdecke, Germany, conducting experiments in collaboration with R. van Eldik, professor of inorganic chemistry. These experiments involved measuring the spectrum of the transient iodine species, I_2OH^-, using a rapid-scan, diode-array spectrophotometer. Temperature-jump spectrophotometric measurements were made of the rate of attainment of the dimerization equilibrium involving di- and bichromate, as well as the rate of formation of CrO_3X^{n-}, where X represents 11 different ligands. The traveler and J. M. Simonson (Chemistry Division, ORNL) presented the results of their two year, EPRI sponsored investigation of the volatility of NH_4Cl to an international committee representing 11 countries in Mannheim. The traveler gave an oral presentation at the subsequent international conference in Heidelberg. This talk raised the possibility of future collaboration on the measurement of pH at high temperatures with research groups in Italy and the USA. Finally, a seminar was presented at the CNRS in Nancy, France, and discussions were held with Dr. C. Nguyen-Trung (CREGU, Nancy) concerning continued collaborative research in the field of uranium chemistry.

24112 (PNL-SA–21663) **Reverse micelle synthesis of nanoscale metal containing catalysts.** Darab, J.G.; Fulton, J.L.; Linehan, J.C. Pacific Northwest Lab., Richland, WA (United States). Mar 1993. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-930304–19: 205. American Chemical Society national meeting, Denver, CO (United States), 28 Mar - 2 apr 1993). Order Number DE93012869. Source: OSTI; NTIS; GPO Dep.

The need for morphological control during the synthesis of catalyst precursor powders is generally accepted to be important. In the liquefaction of coal, for example, iron-bearing catalyst precursor particles containing individual crystallites with diameters in the 1-100 nanometer range are believed to achieve good dispersion through out the coal-solvent slurry during liquefaction 2 runs and to undergo chemical transformations to catalytically active iron sulfide phases. The production of the nanoscale powders described here employs the confining spherical microdomains comprising the aqueous phase of a modified reverse micelle (MRM) microemulsion system as nanoscale reaction vessels in which polymerization, electrochemical reduction and precipitation of solvated salts can occur. The goal is to take advantage of the confining nature of micelles to kinetically hinder transformation processes which readily occur in bulk aqueous solution in order to control the morphology and phase of the resulting powder. We have prepared a variety of metal, alloy, and metal- and mixed metal-oxide nanoscale powders from appropriate MRM systems. Examples of nanoscale powders produced include Co, Mo-Co, Ni_3Fe, Ni, and various oxides and oxyhydroxides of iron. Here, we discuss the preparation and characterization of nickel metal (with a nickel oxide surface layer) and iron oxyhydroxide MRM nanoscale powders. We have used extended x-ray absorption fine structure (EXAFS) spectroscopy to study the chemical polymerization process in situ, x-ray diffraction (XRD), scanning and transmission electron microcroscopies (SEM and TEM), elemental analysis and structural modelling to characterize the nanoscale powders produced. The catalytic activity of these powders is currently being studied.

24113 (UCRL-JC–109948) **The importance of hard core repulsion in models of activity coefficients in aqueous electrolyte solutions: Illustration in the case of hydration theory.** Wolery, T.J.; Jackson, K.J. Lawrence Livermore National Lab., CA (United States). Jul 1992. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-920761–17: 7. water-rock interaction conference, Park City, UT (United States), 9-23 Jul 1992). Order Number DE93012476. Source: OSTI; NTIS; GPO Dep.

Activity coefficients in aqueous electrolyte solutions are primarily affected by two kinds of phenomena. The standard Debye-Huckel equation represents only one of these, the long range electrical interactions. Of nearly equal importance is hard core (HC) repulsion, which is not electrical in nature. To a first-order approximation, HC repulsive effects are independent of the ionic strength, depending instead on the sum of the solute molalities (Σm). Adding a term for HC repulsion to the standard Debye-Huckel model produces what we call a hybrid two-term model In a previous work (Wolery and Jackson 1990) we proposed a new method for making hydration corrections to the standard Debye-Huckel model. In the present work, we examine the effect of extending this model to include hard core repulsion. Although the activity coefficients of 1:1 electrolytes can be fit quite well by the model without a HC term the inclusion of such a term is critical to success in fitting the data for 2:1 and other higher-order electrolytes.

24114 (UCRL-JC–110049-Rev.1) **Polymeric nitrogen: Revision 1.** Mailhiot, C.; Yang, L.H.; McMahan, A.K. Lawrence Livermore National Lab., CA (United States). Aug 1992. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9204235–2-Rev.1: 1992 Air Force high energy density materials contractors meeting, Lancaster, CA (United States), 12-14 Apr 1992). Order Number DE93012600. Source: OSTI; NTIS; GPO Dep.

Ab initio local-density functional total-energy calculations indicate that a polymeric form should be the stable phase of nitrogen above $\sim$ 35 GPa, and that such a polyermic phase is likely to be both energetic and metastable at atmospheric pressure. These results also suggest that such a polymeric form of nitrogen may survive metastably at atompsheric pressure as an energetic, high-melting temperature, insulating solid, with a specific enthalpy of 6.7–14.1 MJ/kg. While this does not exceed the Air Force HEDM goal of 15 MJ/kg, such a material may nevertheless compare favorably with existing monopropellants. 2 figs., 24 refs.

4004 Electrochemistry

Refer also to citation(s) 22888, 23693, 24035, 24292, 24777

4005 Photochemistry

Refer also to citation(s) 23268, 23733, 23803, 24101, 24424, 24587, 24802

24115 (CONF-921276–, pp. 239-242) **Degradation of environmental pollutants by solar energy. Part 3.: Visible light enhancement of the degradation of organophosphorous compounds by hydrogen peroxide in presence of iron salt.** Inoue, Y. (Tokai University, Tokyo (Japan)). 3 Dec 1992. 305p. (In Japanese). From 1992 Japan Solar Energy Society, Japan Wind Energy Association joint converence; Osaka (Japan); 3-4 Dec 1992. In *1992 JSES (Japan Solar Energy Society)/JWEA (Japan Wind Energy Association) Joint Conference*. Order Number DE93793955. Source: OSTI; NTIS (US Sales Only).

Decomposing environmental pollutants using solar energy was discussed. Aqueous solution of organophosphorous compounds was selected as the discussion object. When the solution is oxidized with hydrogen peroxide using iron salt as a catalyst, the reaction progressed rapidly. Irradiating a light on this reaction system accelerated the reaction, evidencing a presence of reaction species that absorb the light. An intermediate in which organophosphorous compounds and hydrogen peroxide are coordinated in iron ions is relatively stable, but exhibits strong oxidizing power when it absorbs a light and oxidizes surrounding ligands completely. Hydrogen peroxide works upon where O=P, an excellent σ donor, is coordinated in the iron ions, and coordinates in the iron in the form of water. The material discharges hydrogen ions at this time, turning into a chemical species A, and further turning into ferryl, a high-order iron oxide (chemical species B) discharging hydroxide ions. The chemical species B has a strong oxidizing power when it absorbs a light. (It makes some oxidizing action even under shielded light.) This decomposition system is effective for treating highly concentrated organophosphorous waste liquid. 11 figs.

24116 (DOE/ER/13439–8) **Infrared absorption spectroscopy and chemical kinetics of free radicals: Progress report.** Curl, R.F.; Glass, G.P. Rice Univ., Houston, TX (United States). Apr 1993. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG05-85ER13439. Order Number DE93015078. Source: OSTI; NTIS; GPO Dep.

During the last year, three projects were completed: a high resolution spectroscopic study of CH stretch of HCCN, measurement of rate constant of reaction between ethynyl (CCH) and H_2 at 295–875 K, and measurement of recombination rate of propargyl (CH_2CCH) at room temperature. (DLC)

24117 (DOE/ER/14024–4) **Dynamics of charge-transfer excited states relevant to photochemical energy conversion: Technical report, June 1, 1992–March 30, 1993.** Lim, E.C. Akron Univ., OH (United States). Dept. of Chemistry. 1993. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-89ER14024. Order Number DE93013981. Source: OSTI; NTIS; GPO Dep.

A systematic study of intramolecular photoassociation and photoinduced charge transfer (CT) was initiated in bichromophoric systems of M-X-M, where two identical aromatic hydrocarbons M are joined by X=CH_2, O, NH, etc. Dinaphthylamines, dinaphthylethers, and dinaphthylmethanes in nonpolar solvents form triplet excimers, following inter system crossing of singlets to the triplet manifold; in polar solvents, the molecule forms an intramolecular CT state. The interchromophore interaction study was extended to N-phenyl-2-naphthylamine. The lowest excited singlet states of the dinaphthylamines were studied by semiempirical quantum chemical methods. Exciplex formation was studied in excited states of jet-cooled van der Waals complexes, such as fluorene/substituted benzenes and 1-cyanonaphthalene-aliphatic amines.

24118 (DOE/ER/14156–2) **Photodissociation and spectroscopy of gas phase bimetallic clusters: Annual progress report.** Duncan, M.A. Georgia Univ., Athens, GA (United States). Research Foundation. May 1992. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG09-90ER14156. Order Number DE93015559. Source: OSTI; NTIS; GPO Dep.

Focus of the research program is the study of gas phase metal clusters for modeling fundamental interactions on metal surfaces. We characterize the chemical bonding between component atoms in clusters as well as the bonding in adsorption on cluster surfaces. Electronic spectra, vibrational frequencies and bond dissociation energies are measured for both neutral and ionized clusters with laser/mass spectrometry techniques. Small bimetallic cluster cations containing Bi/Cr, Bi/Fe, Sn/Bi, and Pb/Sb were photodissociated at various uv wavelengths. Silver dimer van der Waals complexes were produced with a series of rare gas atoms (Ar, Kr, Xe), and their vibrational frequencies and dissociation energies were obtained. (DLC)

4006 Radiation Chemistry

Refer also to citation(s) 22996, 24875

24119 (JINR–18-91-429) **The extraction of radiolysis in the process of sensibilization of heavy ion tracks in polyethyleneterephthalate by a solvent.** Apel', P.Yu.; Kravets, L.I. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of Nuclear Reactions. 1991. [10p.] (In Russian). Order Number DE93625326. Source: OSTI; NTIS (US Sales Only); INIS.

The process of extraction of low-molecular fraction polyethyleneterphthalate (PETP) irradiated with accelerated heavy ions was ivestigated under treatment by a set of solvents. The results of the experiments show that the increase of the volume which leads to the increasing etchability of the tracks is caused mainly by removing polymer destruction products. 11 refs.; 4 figs.; 2 tabs.

4007 Radiochemistry and Nuclear Chemistry

Refer also to citation(s) 22867, 22994, 23171, 23173, 23471, 24108, 24110, 24111, 24139, 24856, 24977

24120 (DOE/FTR–93011416) **[Technology transfer concerning plutonium handling]: Trip report, July 19–24, 1992 and August 9–14, 1992.** Leck, W.C. EG and G Rocky Flats, Inc., Golden, CO (United States). Rocky Flats Plant. 4 Sep 1992. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC34-90DP62349. Order Number DE93011416. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Information was exchanged on the dry machining of plutonium, and on processing and ES&H activities

24121 (JAERI-M–93-052) **Statistical thermodynamic properties of uranium hexafluoride.** Oda, Tetsuzo (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Tokai Research Establishment). Japan Atomic Energy Research Inst., Tokyo (Japan). Mar 1993. 55p. Order Number DE93797608. Source: OSTI; NTIS; INIS.

Statistical thermodynamic properties of uranium hexafluoride (UF_6) for extended temperature range are investigated using simulation techniques. As useful information 200 vibrational states are specifically tabulated, where these are shown in the order of population at a temperature of 300 K. Simulations of UF_6 ν_3 band contour were made in order to investigate the isotopic selectivity. These revealed that the real spectrum should be quasi-continuous feature heavily overlapped by a number of hot bands, while the selectivity should slightly depend on the absorption frequency. The present study would provide useful information for designing of the 'Infrared Uranium Enrichment Monitoring System' for safeguards on a gas centrifuge type uranium enrichment plant, and for other fundamental analyses of infrared spectra. (author).

24122 (RCM–01192) **Effects of humic substances on the migration of radionuclides: Complexation of actinides with humic substances. Second progress report.** Kim, J.I.; Rhee, D.S.; Wimmer, H.; Buckau, G.; Klenze, R.; Decambox, P.; Moulin, C.; Moulin, V.; Tits, J.; Marquardt, C.; Herrmann, G.; Trautmann, N.; Dierckx, A.; Vancluysen, J.; Maes, A. Technische Univ. Muenchen, Garching (Germany). Inst. fuer Radiochemie. Sep 1992. 90p. Contract CEC FI2W-CT91-0083. Order Number DE93795289. Source: OSTI; NTIS (US Sales Only); INIS.

The aim of the present research programme is to study the complexation behaviour of actinide ions with humic substances in natural aquifer systems and hence to quantify the effect of humic substances on the actinide migration. Aquatic humic substances commonly found in all groundwaters in different concentrations have a strong tendency towards complexation with actinide ions. This is one of the major geochemical reactions but hitherto least quantified. Therefore, the effect of humic substances on the actinide migration is poorly understood. In the present research programme the complexation of actinide ions with humic substances will be described thermodynamically. This description will be based on a model being as simple as possible to allow an easy introduction of the resulting constants into geochemical modelling of the actinide migration. (orig.).

24123 (RCM–01192, pp. 1-20) **Complexation of trivalent metal ions (Am^{3+},Cm^{3+}) with humic acid: A comparison of different experimental methods.** Kim, J.I. (Technische Univ. Muenchen, Garching (Germany). Inst. fuer Radiochemie); Rhee, D.S.; Wimmer, H.; Buckau, G.; Klenze, R. Technische Univ. Muenchen, Garching (Germany). Inst. fuer Radiochemie. Sep 1992. Contract CEC FI2W-CT91-0083. In *Effects of humic substances on the migration of radionuclides: Complexation of actinides with humic substances. Second progress report.* 90p. Order Number DE93795289. Source: OSTI; NTIS (US Sales Only); INIS.

The complexation of trivalent metal ions with humic acid has been studied at pH4 and 5 in 0.1 M $NaClO_4$ by three different experimental methods, i.e. UV spectroscopy, time resolved laser fluorescence spectroscopy (TRLFS) and ultrafiltration. The direct speciation of the metal ion and its humate complex in the reaction process has been made by UV spectroscopy for Am(III) in the micromolar concentration range and by TRLFS for Cm(III) in the nanomolar concentration range. The ultrafiltration is used with the lowest pore size of filter (ca. 1 nm) to separate the uncomplexed metal ion from its complexed species. The concentrations of both metal ion and humic acid are varied in such a manner that the effective functional groups of the humic acid becomes loaded with metal ions from 1% to nearly 100%. The loading capacity of the humic acid for the trivalent metal ion, determined separately at eacy pH, is introduced into the evaluation of complexation constants. The metal ion concentration varied from $6x10^{-8}$ mol/L to $4x10^{-5}$ mol/L does not show any concentration effect on the complexation reaction. The three different methods give rise to constants being comparable with one another. The average value

of the constants thus determined is logss = 6.24 ± 0.28 for the trivalent actinide ions. (orig.).

24124 (RCM–01192, pp. 90) **Complexation of lanthanides and actinides with humic acids.** Decambox, P. (Commissariat a l'Energie Atomique, 92 - Fontenay-aux-Roses (France). Dept. des Procedes de l'Enrichissement); Moulin, C.; Moulin, V.; Tits, J. Technische Univ. Muenchen, Garching (Germany). Inst. fuer Radiochemie. Sep 1992. Contract CEC FI2W-CT91-0083. In *Effects of humic substances on the migration of radionuclides: Complexation of actinides with humic substances. Second progress report.* 90p. Order Number DE93795289. Source: OSTI; NTIS (US Sales Only); INIS.

The interactions between humic substances and radioelements have been studied by using a spectroscopy method: Time-Resolved Laser-Induced Spectrofluorometry (TRLIS). In particular, this technique is used for lanthanides (Dy) and actinides (Cm). The TRLIS method consists of the measurement of the fluorescence signal increase of the studied cation when adding a complexing agent (humic substances). The analysis of such titration curves permits to obtain informations on the interaction constants and the complexing capacities of the humic materials towards the studied cation. (orig./BBR).

24125 (RCM–01192, pp. 1-10) **Further investigations of the humate complexation of very low concentrations of neptunium(V).** Marquardt, C. (Mainz Univ. (Germany). Inst. fuer Kernchemie); Herrmann, G.; Trautmann, N. Technische Univ. Muenchen, Garching (Germany). Inst. fuer Radiochemie. Sep 1992. Contract CEC FI2W-CT91-0083. In *Effects of humic substances on the migration of radionuclides: Complexation of actinides with humic substances. Second progress report.* 90p. Order Number DE93795289. Source: OSTI; NTIS (US Sales Only); INIS.

Further investigations were made by continuous electrophoretic ion focusing on the humate complexation of Np(V) in very low concentrations - about 10^{-13} M - at ionic strength 0.01 M, pH 5 and various humic acid concentrations. In addition an anion exchange chromatographic technique with DEAE-Sephadex A25 was applied to separate Np-humate from free Np(V). With both separation techniques the ratio Np_{bound}/Np_{free} was determined and from this an estimate of the interaction constant ss for humate complexation of Np(V) was made. A logss of 5.18 ± 0.08 was obtained by ion focusing and 5.26 ± 0.05 by anion exchange chromatography under the assumption of a humic acid loading capacity of 5%. Experiments of humate complexation of neptunium in presence of calcium have shown that calcium acts as a competing ion and diminishes the complexation of trace amounts of neptunium. (orig.).

24126 (RCM–01192, pp. 1-26) **Effects of humic substances on the migration of radionuclides: Complexation of actinides with humic substances in natural aquatic systems.** Dierckx, A. (Katholieke Univ. Leuven, Heverlee (Belgium). Lab. voor Colloidchemie); Vancluysen, J.; Maes, A. Technische Univ. Muenchen, Garching (Germany). Inst. fuer Radiochemie. Sep 1992. Contract CEC FI2W-CT91-0083. In *Effects of humic substances on the migration of radionuclides: Complexation of actinides with humic substances. Second progress report.* 90p. Order Number DE93795289. Source: OSTI; NTIS (US Sales Only); INIS.

This report covers the study of the interaction of Eu with Aldrich humic acid. The interaction constant will be defined as ss = EuL/(Eu*HA)[III] = M_b/M_f*HA[III] in which EuL and Eu are expressed in mol/l and HA[III] in tridentate sites/l of humic acid (HA). Two main aspects are dealt with: 1. The characterization of the HA ligand HA[III] in terms of its acid-base behaviour in neutral electrolyte solution, its interaction with trivalent cobaltihexammine (CoHM) and its complexation capacity for Eu. 2. Extension of the determination of the Eu interaction constant from low pH values (pH range 3 to 6) as described in the previous report (Dierckx et al, 1992) to higher pH values. (orig.).

4008 Combustion, Pyrolysis, and High-Temperature Chemistry

Refer also to citation(s) 22752, 22847, 22863, 22992, 23732, 23799, 24092, 24267, 24268, 24469, 24510, 24511, 24512, 24937, 24938

24127 (CONF-921275–, pp. 11-14) **Hazard evaluation on peracetic acid manufacturing process.** Tanaka, N. (Sumitomo Chemical Co. Ltd., Osaka (Japan)); Kikuchi, T.; Hirabae, Y.; Ichimura, K. 2 Dec 1992. 160p. (In Japanese). From 25. safety engineering study meeting; Kitakyushu (Japan); 2-3 Dec 1992. In *Proceedings of the 25th Safety Engineering Study Meeting.* Order Number DE93793904. Source: OSTI; NTIS (US Sales Only).

Discussions were given on hazard and safety measures for equilibrium peracetic acid manufactured from acetic acid and hydrogen peroxide. The material is composed of acetic acid at 27%, peracetic acid at 30%, and others. It decomposes at low temperatures, has higher impact sensitivity than m-Dinitrobenzene, and propagates a detonation. It has as large power as 53% of TNT, and its decomposition is accelerated when an impurity is mixed. It may decompose abnormally when heated. If reacted until it reaches an equilibrium by adding hydrogen peroxide with a concentration of 60% into acetic acid, latent hazard increases at a point when half of the hydrogen peroxide has been added. Heat may be removed efficiently if a quantity to be handled is as small as 500 g or less without a problem even at 40°C, but a 4 , reaction run-away may occur in a quantity of about one ton if the temperature exceeds 26°C. An abnormal decomposition phenomenon is a gaseous phase explosion because of abrupt temperature rise in gaseous phase that is not seen in a normal decomposition. Required safety measures may include controlling impact, heat, concentration, temperature, oxygen concentration, and impurities, as well as emergency cooling and extracting facilities, and rapture disks. 2 refs., 2 figs., 4 tabs.

24128 (CONF-921275–, pp. 81-84) **Effects of inclination angles to perpendicular direction on PMMA flat plate imposed on burning behavior.** Ota, K. (Yokohama National Univ., Yokohama (Japan). Faculty of Engineering); Otani, H.; Uehara, Y. 2 Dec 1992. 160p. (In Japanese). From 25. safety engineering study meeting; Kitakyushu (Japan); 2-3 Dec 1992. In *Proceedings of the 25th Safety Engineering Study Meeting.* Order Number DE93793904. Source: OSTI; NTIS (US Sales Only).

It is critical to know behavior of burning solids on a slanted plane in a room fire. Therefore, a discussion was given on effects of inclination angles on combustibility using PMMA flat plates as a combustible solid. The test samples are of square with a side from 30 mm to 100 mm and a thickness of 30 mm, with their bottoms and sides surrounded with 10-mm thick heat insulating boards. The experimental equipment has such a construction that a test specimen is placed on an L-shaped beam, supported on a point of support and a load cell, and can adjust the inclination angles in a range of ±90°. The test specimens were heated and ignited using a gas burner to record weight losses, temperatures at each part, and flame heights, and observed with a video camera. The results of the experiment revealed that the inclination angle dependence of combustion rates can be quantified using empirical laws of natural convection heat transfer, that is, the velocity of retrogression of the surface as a result of combustion can be expressed with a function of the inclination angle and the lengths of the specimen sides, and the combustion velocity can be presented by a primary function of the heat transfer coefficient in the whole inclination range. 6 refs., 7 figs.

24129 (CONF-921275–, pp. 89-92) **Numerical study on non-fire alarm due to cigarette smoke.** Sato, A. (Fire Research Institute, Tokyo (Japan)). 2 Dec 1992. 160p. (In Japanese). From 25. safety engineering study meeting; Kitakyushu (Japan); 2-3 Dec 1992. In *Proceedings of the 25th Safety Engineering Study Meeting.* Order Number DE93793904. Source: OSTI; NTIS (US Sales Only).

Non-fire alarms issued from an automatic fire alarm due to cigarette smoke gives a large adverse effect to the fire alarm reliability, but there is a problem that the smoke signal is difficult to distinguish from smoking of an actual fire. Accordingly, with an objective of identifying its characteristics, an investigation was made

on flowing characteristics of a cigarette smoke around a smoke sensor using an experiment and a numerical calculation. As a result of measuring the smoke concentrations under various conditions using a photoelectric smoke sensor installed at the center of a ceiling, it was found that a non-fire alarm is caused from smoke with large particulate sizes blown out upward from a mouth of a person, and that smoke smoking naturally from a cigarette placed in an ash tray scatters and gets diluted before reaching the ceiling causing little possibility of a non-fire alarm. A numerical simulation clarified the flow velocities of air conditioning air-flows, the time-based change in the smoke movement and diffusion when the cigarette smoke blowing out directions were varied, and the appearance of smoke not reaching a sensor depending on the flows. 6 refs., 11 figs.

24130 (CONF-921275–, pp. 93-96) **Ignitin of silane-oxygen-nitrogen gas mixture.** Kondo, S. (National Chemical Laboratory, for Industry, Tsukuba (Japan)); Urano, Y.; Horiguchi, S.; Iwasaka, M.; Tokuhashi, K.; Nagai, H. 2 Dec 1992. 160p. (In Japanese). From 25. safety engineering study meeting; Kitakyushu (Japan); 2-3 Dec 1992. In *Proceedings of the 25th Safety Engineering Study Meeting.* Order Number DE93793904. Source: OSTI; NTIS (US Sales Only).

Silane, or that diluted with an inert gas, ignites spontaneously when it has flown out into air, but on the other hand has a high explosion lower limit in air allowing it to exist stably even with a concentration of 5% or higher. Accordingly, a discussion was given to elucidate this seemingly contradictory phenomenon. A mixing equipment using a cylindrical glass container performed an operation of gas discharge under normal temperature → introduction of 5.09% oxygen/nitrogen gas mixture and 10 % nitrogen → stirring → introduction of silane/nitrogen gas mixture. Occurrence of spontaneous ignition was observed visually. What has been verified in the mixing experiment at different proportions is as follows: With a silane-air-nitrogen mixture with the silane concentration of about 1% or lower, a possibility of spontaneous ignition exists only in a region with very little oxygen at an air concentration of less than 0.4%; and if white powder (with SiO2 as the main component) that has been once ignited is kept inadvertently deposited on the container, its catalytic action can cause a spontaneous ignition under normal temperature and pressure almost regardless of the mixture concentration. 2 refs., 3 figs.

24131 (CONF-921275–, pp. 97-100) **Explosion risks in silane.: Gas mixture with etching gas.** Horiguchi, S. (National Chemical Laboratory for Industry, Tsukuba (Japan)). 2 Dec 1992. 160p. (In Japanese). From 25. safety engineering study meeting; Kitakyushu (Japan); 2-3 Dec 1992. In *Proceedings of the 25th Safety Engineering Study Meeting.* Order Number DE93793904. Source: OSTI; NTIS (US Sales Only).

Discussions were given on explosion risks in gas mixture of silane (SiH4) with such etching gases used in semiconductor manufacturing processes as SF6, CF4, BF3, and SF4. The explosion limits were measured using a pressure container (100 mm in diameter×100 mm in height, with stirring blades) by means of igniting the gas mixture fusing a nichrome wire at its center to determine occurrence of an explosion from temperature, pressure change and the state of residues in the container. The experiment was carried out all in room temperature and atmospheric pressure, and the gases were mixed using a partial pressure process. As a result, such findings were obtained as data for the explosion pressure ratios to the gas concentrations and the flame temperatures, and the residues. The result may be summarized as follows: The SF6/silane system had a high explosion risk with an explosion range from 10.1% to 89.9% by volume; the SF4 system also has a similar explosion risk; and the CF4 and BF3 systems have low explosion risks. 4 refs., 4 figs.

24132 (CONF-921275–, pp. 129-132) **Study on pyrolytic behavior of nitroanthraquinone.** Sakata, N. (Yokohama National University, Yokohama (Japan). Faculty of Engineering); Otani, H.; Uehara, Y. 2 Dec 1992. 160p. (In Japanese). From 25. safety engineering study meeting; Kitakyushu (Japan); 2-3 Dec 1992. In *Proceedings of the 25th Safety Engineering Study Meeting.* Order Number DE93793904. Source: OSTI; NTIS (US Sales Only).

This paper describes a discussion on the behavior and mechanism of heat decomposition in several nitro compounds of anthraquinone used for manufacturing quinone-based dyes, from the viewpoint of dealing with their risks of heat generation. Experiments were carried out including thermal analyses using thermogravimetry and differential scanning calorimetry (with temperature raising rate of 10°C /min), and gas chromatographic analyses using temperature raising methods. Test specimens used were 1-nitroanthraguinone (1-NAQ), 1, 5-dinitroanthraguinone and 1, 8-dinitroanthraquinone. The result of findings may be summarized as follows: The above two dinitro compounds showed approximately the same results in pyrolytic temperatures, generation rates of decomposed gases, and pressure vessel tests, which suggest that their pyrolytic mechanisms do not differ much, but do the starting process of thermal decomposition; and nitro-group reduction took place in the 1-NAQ pyrolytic process as the decomposition temperature was raised. 2 refs., 5 figs., 3 tabs.

24133 (CONF-921275–, pp. 155-156) **Thermal explosion limit temperatures in liquids.** Kotoyori, T. (Research Institute of Industrial Safety, Tokyo (Japan)). 2 Dec 1992. 160p. (In Japanese). From 25. safety engineering study meeting; Kitakyushu (Japan); 2-3 Dec 1992. In *Proceedings of the 25th Safety Engineering Study Meeting.* Order Number DE93793904. Source: OSTI; NTIS (US Sales Only).

This paper proposes equations to derive thermal explosion limit temperatures in such liquids as liquid organic peroxides. The Semenov's conditional expression for thermal explosion limit (Semenov's expression) is an equation to express the ratio between heat generating rate and heat dissipating rate when a fluid hypothesized to have a uniform internal temperature distribution is placed in an ultimate condition to cause an explosion. The Semenov's equation displaces reaction-kinetic and thermal parameters and an 'S' liquid size into an observable physical amount and makes it a simple form. However, because physical amount relating to a container is not included, and the actually existing liquid is put in the container placed in the gravity field, the equation has to express the physical amount in actual values in 'hr' with respectively different collective coefficients 'h' for heat transfer. The product value of 'hr' and 'Sr' of a certain container can be derived from measurements, whereas the 'hrSr' term can be deleted. With this equation, a thermal explosion limit temperature of an actually existing liquid put in an optional container at an optional amount can be calculated based only on a physical amount that can be readily and accurately measured. Calculations of liquid organic peroxides were compared with measurements. 1 tab.

24134 (DOE/ER/13878–5) **[Homogeneous-hetergeneous combustion: Thermal and chemical coupling: Annual report].** Minnesota Univ., Minneapolis, MN (United States). [1993]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-88ER13878. Order Number DE93016050. Source: OSTI; NTIS; GPO Dep.

Fundamental studies of reactions at low pressures and of boundary layers give microscopic information on homogeneous-heterogeneous reactions. Ignition and extinction studies over simple geometries give basic bifurcation behavior with which to characterize multiple steady states and their stabilities and (hopefully) to identify the types of behavior which may occur. Oxidation of methane, propane, and ammonia were studied; other fuels will be studied. Catalytic monoliths will be used. Modeling will be performed.

24135 (LA–12503-MS) **KIVA-3: A KIVA program with block-structured mesh for complex geometries.** Amsden, A.A. Los Alamos National Lab., NM (United States). Mar 1993. 97p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. Order Number DE93011986. Source: OSTI; NTIS; GPO Dep.

This report describes the KIVA-3 computer program for numerical calculation of transient, two- and three-dimensional chemically reactive fluid flows with sprays. KIVA-3 is an extension of the earlier KIVA-II, uses the same numerical solution procedure, and solves the same set of equations. The full generality of KIVA-II has been retained; thus KIVA-3 is applicable to laminar or turbulent flows, subsonic or supersonic flows, and single-phase or dispersed

two-phase flows. KIVA-3 differs from KIVA-11 in that it uses a block-structured mesh with connectivity defined through indirect addressing. The departure from a single rectangular structure in (i,j,k) logical space allows complex geometries to be modeled with significantly greater efficiency than was previously possible because large regions of deactivated cells are no longer necessary. Cell-face boundary conditions permit greater flexibility and simplification in the application of boundary conditions. This report discusses those features of KIVA-3 that differ from KIVA-II, the input required from a mesh generation preprocessor, and the output provided to a graphics postprocessor. Basic pre and post-processors are included in the KIVA-3 package, and are also described.

24136 (SAND–92-1168C) **Advanced diagnostics for in situ measurement of particle formation and deposition in thermally stressed jet fuels.** O'Hern, T.J.; Trott, W.M.; Martin, S.J.; Klavetter, E.A. Sandia National Labs., Albuquerque, NM (United States). [1993]. 12p. Sponsored by USDOE, Washington, DC (United States); Department of Defense, Washington, DC (United States). DOE Contract AC04-76DP00789. (AIAA–93-0363;CONF-930108–6: 31. American Institute of Astronautics and Aeronautics (AIAA) aerospace sciences meeting, Reno, NV (United States), 11-14 Jan 1993). Order Number DE93009798. Source: OSTI; NTIS; GPO Dep.

Two techniques have been developed and applied for in situ monitoring of processes involved in thermal degradation and solids deposition when several different aviation fuels are thermally stressed. Photon correlation spectroscopy is a dynamic light scattering technique that has proven to be a valuable tool for both real-time and post-test analysis of thermally stressed jet fuels. In situ measurements on post-stressed fuels have shown that significant particle formation can occur at temperatures as low as 120°C, and that relatively large particles (>200 nm mean hydrodynamic diameter) are formed at temperatures less than 200°C. Particle size tends to increase with increasing stress temperature over the range 125°–180°C, with substantial changes in the mean particle size occurring over ranges of only 10–20°C. Real-time measurements indicate that the mean particle diameter increases with increased exposure time at fixed temperature. An induction time is also evident in the real-time data, as an increasingly shorter exposure time is needed for particles to form in detectable size and concentration as the stress temperature is increased. The particle diameters measured post-test, when the fuel has cooled to room temperature, are larger than those measured at elevated temperatures, demonstrating the need for real-time measurements. A complementary experimental system using a quartz crystal microbalance has proven valuable for in situ determination of mass deposition rates during thermal stress tests. These data can be used to determine such kinetic factors as the global activation energies for the tested fuels and for quantitative evaluation of fuel thermal stability.

24137 (SAND–93-0106C) **Coupled thermal response of objects and participating media in fires and large combustion systems.** Gritzo, L.A.; Nicolette, V.F. Sandia National Labs., Albuquerque, NM (United States). [1993]. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-930830–16: National conference and exposition on heat transfer, Atlanta, GA (United States), 8-11 Aug 1993). Order Number DE93012848. Source: OSTI; NTIS; GPO Dep.

When an object is subjected to the flow of combustion gas at a different temperature, the thermal responses of the object and the surrounding gas become coupled. The ability to model this interaction is of primary interest in the design of components which must withstand fire environments. One approach is to decouple the problem and treat the incident flux on the surface of the object as being emitted from a black-body at an approximate gas temperature. By neglecting the presence of the participating media, this technique overpredicts the heat fluxes initially acting on the object surface. The main goal of this work is to quantify the differences inherent in treating the combustion media as a blackbody as opposed to a gray gas. This objective is accomplished by solving the coupled participating media radiation and conduction heat transfer problem. A transient conduction analysis of a vertical flat plate was performed using a gray gas model to provide a radiation boundary condition. A 1-D finite difference algorithm was used to solve the conduction problem. The results are presented in terms of nondimensional parameters and include both average and local heat fluxes as a function of time. Early in the transient, a reduction in net heat fluxes of up to 65% was observed for the gray gas results as compared to the blackbody cases. This reduction in the initial net heat flux results in lower surface temperatures for the gray gas case. Due to the initially reduced surface temperatures, the gray gas net heat flux exceeds the net blackbody heat flux with increasing time. For radiation Blot numbers greater than 5, or values of the radiation parameter less than 10^{-2}. the differences inherent in treating the media as a gray gas are negligible and the blackbody assumption is valid. The results clearly indicate the importance of participating media treatment in the modeling of the thermal response of objects in fires and large combustion systems.

24138 (UCRL-JC–108866) **Molten salt oxidation as an alternative to incineration.** Gray, L.W.; Adamson, M.G.; Cooper, J.F.; Farmer, J.C.; Upadhye, R.S. Lawrence Livermore National Lab., CA (United States). Mar 1992. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-920527–13: 1992 incineration conference, Albuquerque, NM (United States), 11-14 May 1992). Order Number DE93009544. Source: OSTI; NTIS; INIS; GPO Dep.

Molten Salt Oxidation was originally developed by Rockwell International as part of their coal gasification, and nuclear-and hazardous-waste treatment programs. Single-stage oxidation units employing molten carbonate salt mixtures were found to process up to one ton/day of common solid and liquid wastes (such as paper, rags, plastics, and solvents), and (in larger units) up to one ton/hour of coal. After the oxidation of coal with excess oxygen, coal ash residuals (alumina-silicates) were found adhering to the vessel walls above the liquid level. The phenomenon was not observed with coal gasification-i.e., under oxygen-deficient conditions. Lawrence Livermore National Laboratory (LLNL) is developing a two-stage/two-vessel approach as a possible means of extending the utility of the process to wastes which contain high concentrations of alumina-silicates in the form of soils or clays, or high concentrations of nitrates including low-level and transuranic wastes. The first stage operates under oxygen-deficient ("pyrolysis") conditions; the second stage completes oxidation of the evolved gases. The process allows complete oxidation of the organic materials without an open flame. In addition, all acidic gases that would be generated in incinerators are directly metathesized via the molten Na_2CO_3 to form stable salts (NaCl, Na_2SO_4 etc.). Molten salt oxidation therefore avoids the corrosion problems associated with free HCl in incineration. The process is being developed to use pure O_2 feeds in lieu of air, in order to reduce offgas volume and retain the option of closed system operation. In addition, ash is wetted and retained in the melt of the first vessel which must be replaced (continuously or batch-wise). The LLNL Molten Salt unit is described together with the initial operating data.

24139 (WSRC-TR–92-106) **Pyrophoricity of uranium.** Peacock, H.B. Westinghouse Savannah River Co., Aiken, SC (United States). Mar 1992. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE93012138. Source: OSTI; NTIS; GPO Dep.

Uranium metal is pyrophoric and is capable of self-ignition in air provided conditions are favorable. Based on the data in this report, spontaneous ignition of spherical particles larger than 1/16 inch in diameter would not be expected to occur in air at room temperature (25°C). The rate at which the uranium surface oxidizes in air, balanced against the rate at which the heat of reaction is lost to the surroundings, determines whether spontaneous ignition can occur. Heat loss to the surrounding environment depends on the thermal conductivity of the uranium including the oxide coating, and on the temperature gradient. The ignition temperature for uranium metal particles is a function of particle geometry, size or specific surface area, heating rate gas composition as well as the quantity and distribution of powder within a storage container. The most important variable; however, affecting the ignition temperature for single samples was found by Schnizlein and Bingle to be the specific surface area (surface area per gram) of the uranium particles. The ignition temperatures calculated from ANL data for 1/16, 1/4, and 1/2 inch diameter spherical particles are 333, 375, and

399°C, respectively. The accuracy is believed to be about ±l0%, which is based on theoretical and experimental results.

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Refer also to citation(s) 25381

24140 (DOE/FTR–93010290) **[International conference on computational engineering science]: Foreign trip report, December 15–24, 1992.** Gartling, D.K. Sandia National Labs., Albuquerque, NM (United States). 15 Jan 1993. 48p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. Order Number DE93010290. Source: OSTI; NTIS (US Sales Only); GPO Dep.

David Goffing attended the third International Conference on Computational Engineering Science (ICES '92) hosted by the Hong Kong University of Science and Technology. As with previous ICES meetings, the focus of the conference was the presentation of a broad base of research in the general areas of computational fluid and solid mechanics. The conference was held from December 17–22, 1992, in Hong Kong and was attended by approximately 500 delegates representing more than twelve countries; the major contributors to the meeting were the US and Japan. As part of a special symposium on Computational Fluid Dynamics (CFD), Gartling presented an invited paper and chaired one of the five CFD sessions. The paper presentation was titled "On the Question of Time-Dependence in Flow Over a Backward Facing Step," and was co-authored by John Torczynski of Sandia. The work summarized a careful study of a benchmark problem and concluded a debate on the stability of the benchmark flow that had been studied by the CFD community over the last two years. Most of the significant CFD papers at the conference dealt primarily with manufacturing and material processing applications with special emphasis on free boundary problems.

24141 (MLM–3780) **Cable friction study of molybdenum disulfide solid lubricant on 3×7 stainless steel cable.** Herman, G.J. Mound, Miamisburg, OH (United States). 6 May 1993. 20p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-88DP43495. Order Number DE93013079. Source: OSTI; NTIS (US Sales Only); GPO Dep.

A cable friction study was conducted to discover a way of minimizing cable wear in the Detonator Safing Strong Link. Three molybdenum disulfide lubricants were tested on cables that were subjected to a push/pull system simulating the cable action that occurs inside a weapon. Using the Taguchi Method, it was determined from the tests that Everlube 9000, a lubricant made by E/M Corporation, was the best choice and should serve as a solution to the cable friction wear problem with the Detonator Safing Strong Link.

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Refer also to citation(s) 22877, 22895, 22896, 22897, 22898, 22952, 22973, 23052, 23063, 23235, 23455, 23493, 23494, 23510, 23532, 23554, 23601, 23634, 23813, 23848, 24477, 24554, 24561, 24562, 24788, 24964

24142 (CEA-CONF–11230) **TAO-2/SPARTE, a language-enhanced computer aided teleoperation system.** Gravez, P.; Fournier, R. CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Direction des Technologies Avancees. 1991. [8p.] (CONF-9104418–: 2. France-Israel Symposium on Robotics. Advances in non-manufacturing robotics, Saclay (France), 8-10 Apr 1991). Order Number DE93626127. Source: OSTI; NTIS (US Sales Only); INIS.

TAO-2 is a computer system designed by CEA/DTA/UR for the remote control of nuclear servicing servomanipulators. It results from several years of research which have led to the current availability of an industrial product featuring highly advanced performances. For undersea applications, a development has also been carried out with CYBERNETIX for controlling the new hydraulic arm built by this company. An integral element of TAO-2 is the SPARTE language which deals with off-line task programming and focuses on combined manual, automatic and mixed control modes. Additionally, it takes into account the on-line part of the human operator relative to adjustment, monitoring and incident recovery. Other promising features are hybrid control specification, mechanisms for the management of external events and 'learning by touching' capabilities. The present paper describes the basic principles of TAO-2. It first recalls the fundamentals of Computer Aided Teleoperation (CAT). The functional and hardware architectures which implement the TAO-2 CAT concepts are then outlined. The next parts emphasize the original characteristics of the SPARTE control and programming language. The paper ends with a brief presentation of our approach for CAT symbolic control.

24143 (CONF-921275–, pp. 3-6) **Simulation on underground LPG supply system.** Katsuyama, K. (National Institute for Resources and Environment, Tsukuba (Japan)); Kato, S. 2 Dec 1992. 160p. (In Japanese). From 25. safety engineering study meeting; Kitakyushu (Japan); 2-3 Dec 1992. In *Proceedings of the 25th Safety Engineering Study Meeting.* Order Number DE93793904. Source: OSTI; NTIS (US Sales Only).

A field experiment and a simulation were carried out on a system to bury a large-capacity container in the yard of a consumer's home, in place of the conventional bulk shipping container with 20 kg to 50 kg capacity, and supply LPG directly into the container using a small tank lorry. A calculus of finite difference was used to analyze how temperatures in the ground change with time, using a heat transfer equation including the soil thermal conductivity, specific heat, and density. The size of an underground bulk was assumed as a cylinder with a diameter of 1 m and a height of 1 m. Changes in the liquid phase temperatures associated with LPG supply were calculated using a formula by Kato et al. Considerations were given also on heat transfer between the ground and air, and between the ground and the container. For the case of freezing, thermal conductivity of frozen soil was used. A field experiment carried out with a flow rate of 6 kg/h indicated that the liquid temperature drops when a gas is used, and rises when its use is ceased. An error from the calculation result was as good as 4.7%. In a household using gas appliances with total capacity of 3.64 kg/h, the temperature of the liquid and that of soil around the container settled to a constant value in two weeks, and showed no further drop. 2 refs., 4 figs.

24144 (CONF-930403–37) **Overview of the West Valley Vitrification Facility transfer cart control system.** Bradley, E.C.; Rupple, F.R. Oak Ridge National Lab., TN (United States). [1993]. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400 ;AC07-81NE44139. From 5. topical meeting on robotics and remote systems; Knoxville, TN (United States); 26-29 Apr 1993. Order Number DE93010268. Source: OSTI; NTIS; INIS; GPO Dep.

Oak Ridge National Laboratory (ORNL) has designed the control system for the West Valley Demonstration Project Vitrification Facility transfer cart. The transfer cart will transfer canisters of vitrified high-level waste remotely within the Vitrification Facility. The control system will operate the cart under battery power by wireless control. The equipment includes cart mounted control electronics, battery charger, control pendants, engineer's console, and facility antennas.

24145 (CONF-930403–39) **Camera calibration in a hazardous environment performed in situ with automated analysis and verification.** DePiero, F.W.; Kress, R.L. Oak Ridge National Lab., TN (United States). [1993]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 5. topical meeting on robotics and remote systems; Knoxville, TN (United States); 26-29 Apr 1993. Order Number DE93010274. Source: OSTI; NTIS; INIS; GPO Dep.

Camera calibration using the method of Two Planes is discussed. An implementation of the technique is described that may be performed in situ, e.g., in a hazardous or contaminated environment, thus eliminating the need for decontamination of camera systems before recalibration. Companion analysis techniques used for verifying the correctness of the calibration are presented.

24146 (CONF-930403–48) **Remote excavation using the telerobotic small emplacement excavator.** Thompson, D.H.; Burks, B.L.; Killough, S.M. Oak Ridge National Lab., TN (United

States). [1993]. 6p. Sponsored by USDOE, Washington, DC (United States); Department of Defense, Washington, DC (United States). DOE Contract AC05-84OR21400. From 5. topical meeting on robotics and remote systems; Knoxville, TN (United States); 26-29 Apr 1993. Order Number DE93010334. Source: OSTI; NTIS; INIS; GPO Dep.

Oak Ridge National Laboratory is developing remote excavation technologies for the Office of Technology Development, Robotics Technology Development Program. This work is being done to meet the need for remote excavation and removal of radioactive and contaminated buried waste at several DOE sites. System requirements are based on the need to uncover and remove waste from burial sites in a way that does not cause unnecessary personnel exposure or additional environmental contamination. Goals for the current project are to demonstrate dexterous control of a backhoe with force feedback and to implement robotic operations that will improve productivity. The Telerobotic Small Emplacement Excavator is a prototype system that incorporates the needed robotic and telerobotic capabilities on a commercially available platform. The ability to add remote dexterous teleoperation and robotic operating modes is intended to be adaptable to other commercially available excavator systems.

24147 (CONF-9305198–1) **Experiments in mobile robot navigation and range imaging.** Jones, J.P. (Oak Ridge National Lab., TN (United States)); Dorum, O.H.; Andersen, C.S.; Jacobsen, S.V.; Jensen, M.S.; Kierkeby, N.O.S.; Kristensen, S.; Madsen, C.B.; Nielsen, H.M.; Sorensen, E.; Sorensen, J.J.; Christensen, H.I. Oak Ridge National Lab., TN (United States). [1993]. 19p. Sponsored by USDOE, Washington, DC (United States); Danish Ministry of Education (Denmark); Tugborg Foundation (United States); Foundation Vision North (United States); Otto Monsted Foundation; Obel (C.W.) Foundation (United States); Norges Teknisk-Naturv DOE Contract AC05-84OR21400. From 8. Scandanavian conference on image analysis; Tromso (Norway); 25-28 May 1993. Order Number DE93013280. Source: OSTI; NTIS; GPO Dep.

This paper describes some experiments in sensor-based mobile robot navigation conducted at Oak Ridge National Laboratory over the past several years. Two implemented systems are described. One uses a laser range camera as the sole sensor. The other uses, in addition, an array of sonars and a stereo vision system. We discuss a communication system for heterogeneous LAN-connected multiprocessor systems, useful in reasonably large development projects such as these. We also describe some work on the estimation of curvature in range images which introduces a new variational principle motivated by minimization of the change of curvature. Application of this principle is shown to produce results which are more desirable in some respects than those obtained using standard quadratic variation.

24148 (DOE/FTR–93011550) **[Travel to France to study the large ultra-precision machine tools for the SDI sponsored Alpha Laser Program]: Foreign trip report, August 19–September 6, 1992.** Stowers, I.F. Lawrence Livermore National Lab., CA (United States). 5 Oct 1992. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (PEP–92-150). Order Number DE93011550. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The DoD /SDI-DEW Program has asked LLNL to study the feasibility of designing and constructing large ultra-precision machine tools for directly machining and inspecting precision components for the SDI sponsored Alpha Laser Program. Recently, they have asked if single crystal silicon can be machined as easily and accurately, on the LODTM machine at LLNL, as copper was formerly machined. It appears as this is not the case and we are actively seeking a method of reducing the wear of the diamond cutting tool that invariably occurs when silicon is machined.

24149 (DOE/FTR–93012814) **[Travel to France to audit the BR-100 model cask fabrication activities]: Foreign trip report, October 26–November 3, 1991.** Armontrout, C.A. B and W Fuel Co., Lynchburg, VA (United States). 6 Oct 1992. 57p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-92NE34269. Order Number DE93012814. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Travel to France to audit the BR-100 Model Cask fabrication activities.

24150 (DPSPU–74-124-6-Rev.1) **Safety analysis report: Packages SRL 4.5-ton Californium shipping cask (Packaging of fissile and other radioactive materials): Final report, Revision 1.** Whatley, V. Jr.; Mahoney, D.J.; Livingston, J.T. (comps.). Du Pont de Nemours (E.I.) and Co., Aiken, SC (United States). Savannah River Plant. Dec 1974. 88p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001 ;AC09-89SR18035. Order Number DE93013685. Source: OSTI; NTIS; GPO Dep.

This report discussed shielded cask especially designed for shipping californium-252 neutron sources is basically a spherical steel shell filled with water-extended polyester as the shielding material. The cask complies with requirements for shipping "large quantities" of radioactive materials as described in AEC Manual, Chapter 0529, "Safety Standards for Packaging of Radioactive and Fissile Materials." The cask also complies with IAEA "Regulations for the Safe Transport of Radioactive Materials," 1973 Revised Edition.

24151 (EGG-M–92580) **T-Rex system for operation in TRU, LLW, and hazardous zones: Transuranic storage area-retrieval enclosure program.** Kline, H.M. (EG and G Idaho, Inc., Idaho Falls, ID (United States)); Andreychek, T.P.; Beeson, B.K. EG and G Idaho, Inc., Idaho Falls, ID (United States). [1993]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-76ID01570. (CONF-930403–49: 5. topical meeting on robotics and remote systems, Knoxville, TN (United States), 26-29 Apr 1993). Order Number DE93010803. Source: OSTI; NTIS; INIS; GPO Dep.

There are a large number of sites around the world containing TRU (transuranic) waste, low level waste (LLW), and hazardous areas that require teleoperated, heavy lift manipulators with long reach and high precision to handle the materials stored there. Teleoperation of the equipment is required to reduce the risk to operating personnel to as-low-as-reasonably-achievable (ALARA) levels. The Transuranic Storage Area Remote Excavator system (T-Rex) is designed to fill this requirement at low cost through the integration of a production front shovel excavator with a control system, local and remote operator control stations, a closed-circuit television system (CCTV), multiple end effectors and a quick-change system. This paper describes the conversion of an off-the-shelf excavator with a hydraulic control system, the integration of an onboard remote control system, vision system, and the design of a remote control station.

24152 (EGG-WTD–10635) **Test plan for engineering scale electrostatic enclosure demonstration.** Meyer, L.C. EG and G Idaho, Inc., Idaho Falls, ID (United States). Feb 1993. 42p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-76ID01570. Order Number DE93012183. Source: OSTI; NTIS; INIS; GPO Dep.

This test plan describes experimental details of an engineering-scale electrostatic enclosure demonstration to be performed at the Idaho National Engineering Laboratory in fiscal year (FY)-93. This demonstration will investigate, in the engineering scale, the feasibility of using electrostatic enclosures and devices to control the spread of contaminants during transuranic waste handling operations. Test objectives, detailed experimental procedures, and data quality objectives necessary to perform the FY-93 experiments are included in this plan.

24153 (EUR–14497) **Remote laser machining for nuclear site under dismantling (ROLD Program).** Geffroy, J. (CEA Centre d'Etudes de Fontenay-aux-Roses, 92 (France)); Gonnord, J.; Alfille, J.P.; Beaucourt, P. de; Dobler, M.; Ermont, G.; Galey, D.; Garrec, P.; Hofman, M.; Marceau, M.; Mergy, M.; Noel, J.P.; Nomine, J.P. Commission of the European Communities, Luxembourg (Luxembourg). 1993. [116p.] (In French). Contract FI1D-0013F. Source: OSTI; NTIS (US Sales Only); INIS.

This report describes the design, development and manufacturing of a power laser cutting tool remotely-operated, adapted to nuclear installations dismantling. The technological choices adopted for the conception of the laser robot ROLD are presented,

as well as the coupling to a power laser in a real but not radioactive environment. A series of tests on sample cutting performances are presented. A complementary working program with respect to the initial one was intended for the development of an automatic cutting trajectory teaching system. A three dimensional laser camera, assisted by a proximity sensor by optical triangulation would allow to create a picture of the cutting scene which would have been used for the trajectory calculation. The trials have not yet been successful, but the results are presented in the report.

24154 (INDC(NDS)–213/GM3, pp. 29-30) **Remarks on tritium applications and handling at Oak Ridge National Laboratory.** Kobisk, E.H. International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Oct 1988. (CONF-8809159–: 14. world conference of the International Nuclear Target Development Society (INTDS): heavy-ion targets and related phenomena, Darmstadt (Germany), 5-9 Sep 1988). In *The influence of target and sample properties on nuclear data measurements: Summary report of the IAEA advisory group meeting in co-operation with the International Nuclear Target Development Society (INTDS), held in Darmstadt, Germany, 5-9 September 1988.* [74p.] Order Number DE93626092. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. TRITIUM/materials handling; ORNL; REMOTE HANDLING; TRITIUM

24155 (INDC(NDS)–213/GM3, pp. 69) **Tritium-processing operations at the Oak Ridge National Laboratory with emphasis on safe-handling practices.** Kobisk, E.H. (Oak Ridge National Lab., TN (United States)); Ramey, D.W.; Aaron, W.S.; Tompkins, J.A.; Haff, K.W.; Adair, H.L. International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Oct 1988. Contract DE-AC05-84OR21400. (CONF-8809159–: 14. world conference of the International Nuclear Target Development Society (INTDS): heavy-ion targets and related phenomena, Darmstadt (Germany), 5-9 Sep 1988). In *The influence of target and sample properties on nuclear data measurements: Summary report of the IAEA advisory group meeting in co-operation with the International Nuclear Target Development Society (INTDS), held in Darmstadt, Germany, 5-9 September 1988.* [74p.] Order Number DE93626092. Source: OSTI; NTIS (US Sales Only); INIS.

Tritium, a radioactive isotope of hydrogen, is used in many applications, including neutron production from the (d,t) reaction, radioluminescent lighting, helium doping of materials, and radiography. The Isotopes Section of the Oak Ridge National Laboratory (ORNL) has been involved in providing tritium gas and various tritium-containing materials to the international research, development, and production communities for more than 28 years. Many programs at ORNL and other facilities have benefited from the expertise developed within the Isotopes Section for preparing tritium-containing materials such as titanium or erbium tritide for use in neutron production through the development of radioluminescent lighting or through the use of tritium to implant ^{3}He in tensile specimens. A major consideration in all the operations is to minimize personnel exposure to tritium and to keep this exposure to a level that is as low as reasonably achievable (ALARA). Present and future tritium-processing operations are described. (author). Abstract only.

24156 (JAERI-M–92-192) **Calculations of reactivity effects caused by non-uniform concentration of nuclear fuel.** Okuno, Hiroshi (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Tokai Research Establishment); Sakai, Tomohiro; Shioda, Masayuki. Japan Atomic Energy Research Inst., Tokyo (Japan). Dec 1992. 112p. (In Japanese). Order Number DE93797510. Source: OSTI; NTIS; INIS.

Reactivity effects caused by non-uniformly distributed nuclear fuel concentration were studied through numerical calculations. At first, the criticality quantities of spherical and cylindrical ^{235}U-H_2O and aqueous solution of 5 wt% enriched $UO_2(NO_3)_2$ were obtained, whose fuel concentration distribution is linearly dependent on the square distance from the center of the fuel region. The optimum distributions of aqueous solutions of $UO_2(NO_3)_2$ and $Pu(NO_3)_4$ were obtained by flattening the fuel importance distribution. The effects of dimension and shape of fuel region and with/without reflector on the results of the optimum fuel distribution and neutron multiplication factor were also examined for 5 wt% ^{235}U-enriched uranium UO_2-H_2O fuel. The calculations revealed that the optimum fuel distribution had higher concentration in the center for overmoderated fuel, whereas higher on the periphery for undermoderated fuel. Reflector attached systems produced both centrally and peripherally high fuel distribution for optimum and more moderated fuel. The neutron multiplication factor of the optimum fuel distribution increased by 0 to 4 % relative to that of the uniform distribution. The outline of a computer code OPT-D to obtain the optimum fuel distribution by using the one-dimensional diffusion approximation, inclusive of its manual, was given in an appendix. (author).

24157 (JAERI-M–92-197) **A survey report for the turning of biped locomotion robot.** Kato, Ichiro (Waseda Univ., Tokyo (Japan)); Takanishi, Atsuo; Kume, Etsuo. Japan Atomic Energy Research Inst., Tokyo (Japan). Dec 1992. 52p. (In Japanese). Order Number DE93797511. Source: OSTI; NTIS; INIS.

A mechanical design study of biped locomotion robots is going on at JAERI within the scope of the Human Acts Simulation Program (HASP). The design study at JAERI is of an arbitrarily mobile robot for inspection of nuclear facilities. A survey has been performed for collecting useful information from already existing biped locomotion robots. This is a survey report for the turning of biped locomotion robot: the WL-10R designed and developed at Waseda University. This report includes the control method of turning, machine model and control system. (author).

24158 (JAERI-M–92-206) **Seismic analysis of plutonium glovebox by MSC/NASTRAN.** Hirata, Masaru (Japan Atomic Energy Research Inst., Oarai, Ibaraki (Japan). Oarai Research Establishment); Ishikawa, Kazuya; Korosawa, Makoto; Fukushima, Susumu; Hoshina, Hirofumi. Japan Atomic Energy Research Inst., Tokyo (Japan). Jan 1993. 55p. (In Japanese). Order Number DE93797557. Source: OSTI; NTIS; INIS.

Seismic analysis of the structural strength of gloveboxes is important for plutonium confinement evaluation. However, the analytical methods must be developed for evaluating the mutual displacement between the window frame and acrylic resin window panel with regard to plutonium confinement during an earthquake. Therefore, seismic analysis for a standard glovebox in Plutonium Fuel Research Facility at Oarai Research Establishment of JAERI has been conducted by FEM (Finite Element Method) computer code MSC/NASTRAN (MacNeal-Schwendler Corporation NASA Structural Analysis). Modelling of glovebox window frame has been investigated from the results of natural frequency analysis and static analysis. After the acquisition of a suitable model, displacement around the window frame and glovebox structural strength have been evaluated in detail by use of floor response spectrum analysis and time-history (transient response) analysis. (author).

24159 (JAERI-M–93-031) **Evaluation of effect of solution-density formula on criticality parameters.** Miyoshi, Yoshinori (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Tokai Research Establishment); Hirose, Hideyuki; Ami, Norio; Sakurai, Satoshi. Japan Atomic Energy Research Inst., Tokyo (Japan). Mar 1993. 37p. (In Japanese). Order Number DE93797609. Source: OSTI; NTIS; INIS.

Calculations of the criticality parameters have been performed for solution fuels such as uranyl nitrate, plutonium nitrate and their mixture by use of a newly proposed formula (SST formula) of the solution density. By comparison of the calculated infinitive multiplication factor and critical buckling using SST formula with those by the present formula based on Maimoni's and Burger's, the effect of the density formula for nitrate solution on the criticality calculation were studied. (author).

24160 (KCP–613-5037) **Machine tool error analysis: Final report.** Carnivale, G.L. Allied-Signal Aerospace Co., Kansas City, MO (United States). Kansas City Div. Apr 1993. 161p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00613. Order Number DE93013623. Source: OSTI; NTIS; GPO Dep.

This report addresses sources of geometric error in a machined part due to the error sources of the machine tool structure. Tests were conducted on a Cincinnati Milacron 3-axis T-10 Machining

Center which simulates equipment used in actual production at the Kansas City Division of AlliedSignal Inc. Results indicate that positioning inaccuracies of machine tools can be reduced by using error modeling and prediction to induce compensation.

24161 (LA-UR–93-197) **High temperature heat pipe experiments in low earth orbit.** Woloshun, K. (Los Alamos National Lab., NM (United States)); Merrigan, M.A.; Sena, J.T.; Critchley, E. Los Alamos National Lab., NM (United States). [1993]. 8p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930830–4: National conference and exposition on heat transfer, Atlanta, GA (United States), 8-11 Aug 1993). Order Number DE93007382. Source: OSTI; NTIS; INIS; GPO Dep.

Although high temperature, liquid metal heat pipe radiators have become a standard component on most high power space power system designs, there is no experimental data on the operation of these heat pipes in a zero gravity or micro-gravity environment. Experiments to benchmark the transient and steady state performance of prototypical heat pipe space radiator elements are in preparation for testing in low earth orbit. It is anticipated that these heat pipes will be tested aborad the Space Shuttle in 1995. Three heat pipes will be tested in a cargo bay Get Away Special (GAS) canister. The heat pipes are SST/potassium, each with a different wick structure; homogeneous, arterial, and annular gap, the heat pipes have been designed, fabricated, and ground tested. In this paper, the heat pipe designs are specified, and transient and steady-state ground test data are presented.

24162 (LA-UR–93-1025) **Material removal processes: Engineering mechanics consideration.** Anderson, C.A. Los Alamos National Lab., NM (United States). [1993]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9304106–2: 1993 ASPE spring topical meeting, Tucson, AZ (United States), 13-15 Apr 1993). Order Number DE93010733. Source: OSTI; NTIS; GPO Dep.

In the material removal process called machining, a layer of material of constant thickness is removed from the workpiece by a wedge-shaped tool that travels parallel to the workpiece at a preselected depth. Even though the speed of relative movement between workpiece and tool is low (typical 1–10 M/S), the strain-rates in the workpiece near the tool can be high, on the order of 10^4-10^5 s^{-1}. When machining brittle materials or unlubricated ductile materials at low speed, the removed metal (or chip) will be discontinuous and made up of small fractured segments. On the other hand, when machining ductile material under lubricated conditions, the removed material forms a continuous coil. In this case, we can represent the material removal process as a steady-state process. In this presentation, we will restrict ourselves to orthogonal machining where the cutting edge is perpendicular to the relative motion-a situation also approximated by other material removal processes such as planing and broaching, and turning on a lathe.

24163 (LA-UR–93-1444) **Advanced Field Artillery System gun mount thermal management study: Phase 1 summary.** Merrigan, M. Los Alamos National Lab., NM (United States). 23 Mar 1993. 18p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract W-7405-ENG-36. Order Number DE93012668. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Los Alamos National Laboratory conducted a thermal management study for the AFAS and developed a preliminary design for a thermal control system for the AFAS. The primary component of the thermal management system is the heat exchanger. The heat exchanger is nominally 30-cm long and 17.78-cm in diameter. It employs a copper fin core through which water is circulated at a rate of approximately 13.5 gpm. The water is heated by 7°C in passing through the heat exchanger and undergoes a corresponding pressure drop of approximately 15 psi. Heat rejection to ambient air is accomplished through a water-air heat exchanger located remotely from the recoil modules.

24164 (MLM–3767) **Estimation of strain in 1-kW primary containment vessels by microstructural examination.** Schleitweiler, P.M.; Merten, C.W. Mound, Miamisburg, OH (United States). 19 Apr 1993. 50p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-88DP43495. Order Number DE93013053. Source: OSTI; NTIS; GPO Dep.

Weld sections were analyzed and strain estimated in five 1-kW primary containment vessels submitted to the EG&G Mound Physical Metallurgy Group for evaluation. Four of the vessels had been subjected to compression testing and one was untested. Metallographic sectioning was done on regions of greatest deformation and on weld areas. Strain was estimated by measuring the grain deformation with a line intercept method.

24165 (NEA-CRP-L–331) **NEACRP comparison of codes for the radiation protection assessment of transportation packages. Solutions to problems 1 - 4.** Avery, A.F.; Locke, H.F. UKAEA Atomic Energy Establishment, Winfrith (United Kingdom). Materials Technology Div. Mar 1992. [141p.] Order Number DE93626125. Source: OSTI; NTIS (US Sales Only); INIS.

In 1985 the Reactor Physics Committee of the Nuclear Energy Agency initiated an intercomparison of codes for the calculation of the performance of shielding for the transportation of spent reactor fuel. The results of the application of a range of codes to the prediction of the dose-rates in the four theoretical benchmarks set to examine the attenuation of radiation through a variety of cask geometries are presented in this report. The contributions from neutrons, fission product gamma-rays and secondary gamma-rays are tabulated separately, and grouped according to the type of method of calculation employed. A brief discussion is included for each set of results, and overall comparisons of the methods, codes, and nuclear data are made. A number of conclusions are drawn on the advantages and disadvantages of the various methods of calculation, based upon the results of their application to these four benchmark problems.

24166 (NIIAR–17-800) **Automatic radiometric control system of technological process.** Kroshkin, N.I.; Nazarenko, V.I.; Safonov, V.A.; Krivosheev, V.A.; Loginov, V.D.; Sernov, I.E. Nauchno-Issledovatel'skij Inst. Atomnykh Reaktorov, Dimitrovgrad (Russian Federation). 1990. [8p.] (In Russian). Order Number DE93626129. Source: OSTI; NTIS (US Sales Only); INIS.

A system of remote automatic control for radiochemical and technological processes connected with radioactive substances is described. The control system is created on the MERA-60 computer basis and block complex in the CAMAC format. The computer outer device complex admits two ADCs and controller block of the information output graphical mode that allows the computer to operate in the mode of pulse amplitude analysis by two independent inputs. The program of automatic control is made, the algorithms of spectra processing is proposed. The program provides for automatic operation of the apparatus, visual presenting of information about the process at the display, documenting of the control results with an accuracy evaluation. 2 refs.; 1 fig.

24167 (ORNL/TM–12337) **Whole-arm obstacle avoidance system conceptual design.** Wintenberg, A.L.; Butler, P.L.; Babcock, S.M.; Ericson, M.N.; Britton, C.L. Jr. Oak Ridge National Lab., TN (United States). Apr 1993. 38p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93012093. Source: OSTI; NTIS; INIS; GPO Dep.

Whole-arm obstacle avoidance is needed for a variety of robotic applications in the Environmental Restoration and Waste Management (ER&WM) Program. Typical industrial applications of robotics involve well-defined workspaces, allowing a predetermined knowledge of collision-free paths for manipulator motion. In the unstructured or poorly defined hazardous environments of the ER&WM Program, the potential for significant problems resulting from collisions between manipulators and the environment in which they are utilized is great. The conceptual design for a sensing system that will provide protection against such collisions is described herein. The whole-arm obstacle avoidance system consists of a set of sensor "bracelets," which cover the surface area of the manipulator links to the maximum extent practical, and a host processor. The host processor accepts commands from the robot control system, controls the operation of the sensors, manipulates data received from the bracelets, and makes the data available to the manipulator control system. The bracelets consist of a subset of the sensors, associated sensor interface electronics, and a bracelet interface. Redundant communications links between the

host processor and the bracelets are provided, allowing single-point failure protection. The system allows reporting of 8-bit data from up to 1000 sensors at a minimum of 50 Hz. While the initial prototype implementation of the system utilizes capacitance proximity sensor, the system concept allows multiple types of sensors. These sensors are uniquely addressable, allowing remote calibration, thresholding at the bracelet, and correlation of a sensor measurement with the associated sensor and its location on the manipulator. Variable resolution allows high-speed, single-bit sensing as well as lower-speed higher-resolution sensing, which is necessary for sensor calibration and potentially useful in control.

24168 **Material containment enclosure.** Carlson, D.O. To Dept. of Energy. 1 Apr 1991. USA patent application 7-678,387. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. Order Number DE93008230. Source: OSTI; NTIS; GPO Dep.

An isolation enclosure and a group of isolation enclosures was designed which is useful when a relatively large containment area is required. The enclosure is in the form of a ring having a section removed so that a technician may enter the center area of the ring. in a preferred embodiment, an access zone is located in the transparent wall of the enclosure and extends around the inner perimeter of the ring so that a technician can insert his hands into the enclosure to reach any point within. The inventive enclosures provide more containment area per unit area of floor space than conventional material isolation enclosures.

24169 **Basic fluid system trainer.** Semans, J.P.; Johnson, P.G.; LeBoeuf, R.F. Jr.; Kromka, J.A.; Goron, R.H.; Hay, G.D. To Dept. of Energy. 30 Apr 1991. USA patent application 7-693,477. 19p. Sponsored by USDOE, Washington, DC (United States); Department of Defense, Washington, DC (United States). N00024-79-C4026. Order Number DE93012011. Source: OSTI; NTIS; GPO Dep.

This invention, a trainer mounted and housed within a mobile console, is used to teach and reinforce fluid principles to students. The system trainer has two centrifugal pumps, each driven by a corresponding two-speed electric motor. The motors are controlled by motor controllers for operating the pumps to circulate the fluid stored within a supply tank through a closed system. The pumps may be connected in series or in parallel. A number of valves are also included within the system to effect different flow paths for the fluid. In addition, temperature and pressure sensing instruments are installed throughout the closed system for measuring the characteristics of the fluid, as it passes through the different valves and pumps. These measurements are indicated on a front panel mounted to the console, as a teaching aid, to allow the students to observe the characteristics of the system.

24170 (PNL–8638) **Computer-aided acquisition and logistics support (CALS): Concept of Operations for Depot Maintenance.** Bourgeois, N.C.; Greer, D.K. Pacific Northwest Lab., Richland, WA (United States). Apr 1993. 89p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93013125. Source: OSTI; NTIS; GPO Dep.

This CALS Concept of Operations for Depot Maintenance provides the foundation strategy and the near term tactical plan for CALS implementation in the depot maintenance environment. The user requirements enumerated and the overarching architecture outlined serve as the primary framework for implementation planning. The seamless integration of depot maintenance business processes and supporting information systems with the emerging global CALS environment will be critical to the efficient realization of depot user's information requirements, and as, such will be a fundamental theme in depot implementations.

24171 (SAND–92-0347) **Comparison of analytic Whipple bumper shield ballistic limits with CTH simulations.** Hertel, E.S. Jr. Sandia National Labs., Albuquerque, NM (United States). May 1993. 64p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. Order Number DE93015126. Source: OSTI; NTIS; GPO Dep.

A series of CTH simulations were conducted to assess the feasibility of using the hydrodynamic code for debris cloud formation and to predict any damage due to the subsequent loading on rear structures. Six axisymmetric and one 3-dimensional simulations were conducted for spherical projectiles impacting Whipple bumper shields. The projectile diameters were chosen to correlate with two well known analytic expressions for the ballistic limit of a Whipple bumper shield. It has been demonstrated that CTH can be used to simulate the debris cloud formation, the propagation of the debris across a void region, and the secondary impact of the debris against a structure. In addition, the results from the CTH simulations were compared to the analytic estimates of the ballistic limit. At impact velocities of 10 km/s or less, the CTH predicted ballistic limit lays between the two analytic estimates. However, for impact velocities greater than 10 km/s, CTH simulations predicted a ballistic limit larger than both analytical estimates. The differences at high velocities are not well understood. Structural failure at late times due to the time integrated loading of a very diffuse debris cloud has not been considered in the CTH model. In addition, the analytic predictions are extrapolated from relatively low velocity data and the extrapolation technique may not be valid. The discrepancy between the two techniques should be investigated further.

24172 (SAND–92-2236C) **Incentives for use of inelastic analysis in RAM transport container design.** Ammerman, D.J.; Heinstein, M.W. Sandia National Labs., Albuquerque, NM (United States). [1992]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-930205–62: Waste management '93, Tucson, AZ (United States), 28 Feb - 4 mar 1993). Order Number DE93012858. Source: OSTI; NTIS; INIS; GPO Dep.

The use of inelastic analysis methods instead of the traditional elastic analysis methods in the design of radioactive material (RAM) transport packagings leads to a better understanding of the response ofthe package to mechanical loadings. Thus, better assessment of the containment, thermal protection, and shielding integrity of the package after a structural accident event can be made. A more accurate prediction of the package response can lead to enhanced safety and also allow for a more efficient use of materials, possibly leading to a package with higher capacity and/or lower weight. This paper discusses the incentives for using inelastic analysis in the design of RAM shipping packages. Inelastic analysis provides an improved knowledge of the package behavior. It must be demonstrated that the use of inelastic analysis provides a better design to overcome the difficulties associated with this type of analysis. In this paper, comparisons between elastic and inelastic analyses are made to illustrate the differences in the two analysis techniques for two different types of packages. One is a package to transport a large quantity of RAM by rail with lead gamma shielding,and the other is a package to transport RAM by truck with depleteduranium gamma shielding. Analyses of the center-of-gravity-over-corner impacts will be compared for each package. The comparisons indicate thata package designed to just meet the elastic design criteria will actually undergo some yielding in the locations of highest stress. This results in two consequences in the predicted behavior of the cask. First,the overprediction of the stiffness of these yielded regions by theelastic analysis technique results in an underestimation of the stresses in other portions of the structure. Secondly, in an inelastic analysis, the yielding of a portion of a structure causes the force in thatregion to rise less rapidly than forces in adjacent regions.

24173 (SAND–92-2405C) **Data fusion for adaptive control in manufacturing: Impact on engineering information models.** Bray, O.H. Sandia National Labs., Albuquerque, NM (United States). [1992]. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-930862–2: 1993 American Society of Mechanical Engineers (ASME) international computers in engineering conference and exposition, San Diego, CA (United States), 8-12 Aug 1993). Order Number DE93011555. Source: OSTI; NTIS; GPO Dep.

This paper addresses the impact of data fusion on engineering and manufacturing information systems. Data fusion is the integration and analysis of data from multiple sensors to develop a more accurate understanding of a situation and determine how to respond to it. (Sensor fusion, a related term, has a somewhat

different, more implementation oriented focus. The difference between these two concepts is addressed specifically in Section 1.) Although data fusion can be applied in many situations, this paper focuses on its application to manufacturing and how it changes some of the more traditional, less adaptive information models that support the design and manufacturing functions.

24174 (SAND–93-0588C) **Automating the operation of robots in hazardous environments.** Harrigan, R.W. Sandia National Labs., Albuquerque, NM (United States). 21 Feb 1993. 27p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-930736–2: 1993 Institute of Electrical and Electronics Engineers/Robotics Society of Japan (IEEE/RSJ) international conference on intelligent robots and systems (IROS), Yokohama (Japan), 26-30 Jul 1993). Order Number DE93009850. Source: OSTI; NTIS; GPO Dep.

Hazardous operations which in the past have been completed by technicians are under increased scrutiny due to high costs and low productivity associated with providing protective clothing and environments. As a result, remote systems are needed to accomplish many hazardous materials handling tasks such as the clean up of waste sites in which the exposure of personnel to radiation, chemical, explosive, and other hazardous constituents is unacceptable. Traditional remote operations have proven to have very low productivity when compared with unencumbered humans. Computer models augmented by sensing and structured, modular computing environments are proving to be effective in automating many unstructured hazardous tasks.

24175 (SAND–93-0678C) **Adding intelligence to conventional industrial robots.** Harrigan, R.W. Sandia National Labs., Albuquerque, NM (United States). [1993]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-930403–51: 5. topical meeting on robotics and remote systems, Knoxville, TN (United States), 26-29 Apr 1993). Order Number DE93011557. Source: OSTI; NTIS; INIS; GPO Dep.

Remote systems are needed to accomplish many tasks such as the clean up of waste sites in which the exposure of personnel to radiation, chemical, explosive, and other hazardous constituents is unacceptable. In addition, hazardous operations which in the past have been completed by technicians are under increased scrutiny due to high costs and low productivity associated with providing protective clothing and environments. Traditional remote operations have, unfortunately, proven to also have very low productivity when compare with unencumbered human operators. However, recent advances in the integration of sensors and computing into the control of conventional remotely operated industrial equipment has shown great promise for providing systems capable of solving difficult problems.

24176 (SAND–93-0931C) **Integration of rapid prototyping into design and manufacturing.** Atwood, C.L.; McCarty, G.D.; Pardo, B.T. Sandia National Labs., Albuquerque, NM (United States). [1993]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-9305176–1: Rapid prototyping and manufacturing '93 conference and exhibits, Dearborn, MI (United States), 10-13 May 1993). Order Number DE93011554. Source: OSTI; NTIS; GPO Dep.

The introduction of rapid prototyping machines into the market place promises to revolutionize the process of producing prototype parts with production-like quality. In the age of concurrent engineering and agile manufacturing, it is necessary to exploit applicable new technologies as soon as they become available. The driving force behind integrating these evolutionary processes into the design and manufacture of prototype parts is the need to reduce lead times and fabrication costs improve efficiency, and increase flexibility without sacrificing quality. Sandia Utilizes stereolithography and selective laser sintering capabilities to support internal design and manufacturing efforts. Stereolithography (SLA) is used in the design iteration process to produce proof-of-concept models, hands-on models for design reviews, fit check models, visual aids for manufacturing, and functional parts in assemblies. Selective laser sintering (SLS) is used to produce wax patterns for the lost wax process of investment casting in support of an internal Sandia National Laboratories program called FASTCAST which integrates experimental and computational technologies into the investment casting process. This presentation will provide a brief overview of the SLA and SLS processes and address our experiences with these technologies from the standpoints of application, accuracy, surface finish, and feature definition. Also presented will be several examples of prototype parts manufactured by the stereolithography and selective laser sintering rapid prototyping machines.

24177 (UCRL-CR–113495) **MRS-131 Program (WO 121722) Task No. 16: System level test final report.** Maybee, J.C. (Rocket Research Co., Redmond, WA (United States)). Lawrence Livermore National Lab., CA (United States); Rocket Research Co., Redmond, WA (United States). 1 Apr 1992. 174p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE93012319. Source: OSTI; NTIS; GPO Dep.

This report summarizes the results of Task 16 of the MRS-131 Program. The objective of this task was to demonstrate the successful operation of the breadboard pumped propulsion system, using components previously designed and developed on the MRS-131 Program. The components were to be of flight design wherever possible. Prior to the system test, a series of bootstrap tests were to be conducted to verify the capability of the system to bootstrap from propellant tank pressure (50 psia) to full operating pressure (> 1200 psia). The bootstrap tests were very successful; the results showed that the system could bootstrap under all anticipated operating conditions, with margin. The system testing conducted in December, 1991 was only partially successful. Successful bootstrap and limited pulse-mode performance were demonstrated during the test series, however, problems encountered with the 3-way warm gas pump valves forced a curtailment of the test series prior to completion. This precluded demonstration of steady-state performance and mission duty cycle performance. Details on the results of these tests in addition to the design of the system are contained in this report. In addition to the two test series described above, expulsion tests were conducted with RRC heavyweight propellant tanks. A computer model of the pumped propulsion system was created to predict the system's overall performance and establish design specifications for components. As test data became available from component and sub-system tests the model was updated and correlated. The complexity of the model was also increased during this process as more was teamed about the system. This has resulted in a model with a high degree of fidelity in predicting system behavior under a variety of conditions. The model has been quite useful in simulating the effects of component performance changes and the impact these had upon overall system performance.

24178 (UCRL-JC–106140) **Long-range maintenance planning: A case study of working system.** Flanigan, M.J. Lawrence Livermore National Lab., CA (United States). Oct 1991. 18p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9111312–1: 8. international maintenance conference, Dallas, TX (United States), 12-14 Nov 1991). Order Number DE93013088. Source: OSTI; NTIS; GPO Dep.

This paper addresses the development of the Lawrence Livermore National Laboratory (LLNL) Maintenance Planning System (MPS). The pitfalls encountered and overcome, and future expansion plans. The MPS provides the ability to develop and track long-range programs, i.e., conversion of chlorofluorocarbon (CFC) equipment to hydrochlorofluorocaron (HCFC), roofing, roads, etc., in addition to providing invaluable information and data for current year budget justification.

24179 (UCRL-JC–110015) **Monte Carlo code criticality benchmark comparisons for waste packaging.** Alesso, H.P.; Annese, C.E.; Buck, R.M.; Pearson, J.S.; Lloyd, W.R. Lawrence Livermore National Lab., CA (United States). Jul 1992. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9207102–78: Institute of Nuclear Materials Management (INMM) annual meeting, Orlando, FL (United States), 19-22 Jul 1992). Order Number DE93012499. Source: OSTI; NTIS; INIS; GPO Dep.

COG is a new point-wise Monte Carlo code being developed and tested at Lawrence Livermore National Laboratory (LLNL). It solves the Boltzmann equation for the transport of neutrons and photons. The objective of this paper is to report on COG results for

criticality benchmark experiments both on a Cray mainframe and on a HP 9000 workstation. COG has been recently ported to workstations to improve its accessibility to a wider community of users. COG has some similarities to a number of other computer codes used in the shielding and criticality community. The recently introduced high performance reduced instruction set (RISC) UNIX workstations provide computational power that approach mainframes at a fraction of the cost. A version of COG is currently being developed for the Hewlett Packard 9000/730 computer with a UNIX operating system. Subsequent porting operations will move COG to SUN, DEC, and IBM workstations. In addition, a CAD system for preparation of the geometry input for COG is being developed. In July 1977, Babcock & Wilcox Co. (B&W) was awarded a contract to conduct a series of critical experiments that simulated close-packed storage of LWR-type fuel. These experiments provided data for benchmarking and validating calculational methods used in predicting K-effective of nuclear fuel storage in close-packed, neutron poisoned arrays. Low enriched UO2 fuel pins in water-moderated lattices in fuel storage represent a challenging criticality calculation for Monte Carlo codes particularly when the fuel pins extend out of the water. COG and KENO calculational results of these criticality benchmark experiments are presented.

24180 (UCRL-JC–111218) **Application of an interactive controlled gantry robot in a glove box environment.** Merrill, R. Lawrence Livermore National Lab., CA (United States). Apr 1993. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-930491–3: International robots and vision conference, Detroit, MI (United States), 6-8 Apr 1993). Order Number DE93014421. Source: OSTI; NTIS; GPO Dep.

Automating special nuclear materials processing in glove boxes is required to remove the operator from radiation exposure and meet new DOE exposure guidelines. The viability of using robots to achieve this capability has been well established at Lawrence Livermore National Laboratory. From this operational experience it has become clear that there is a need for interactive glove box gantry robot controls to provide the operator with a capability for intervening to recover from unexpected upsets conditions and to carryout one-of-a kind operations which do not lend themselves to autonomous execution. This paper describes the interactive control features required, the developments achieved thus far and the plans for meeting the remaining needs.

24181 (UCRL-JC–112894) **A methodology for calculating the response of structures to earthquakes on specific faults.** McCallen, D.B.; Heuze, F.E.; Kasameyer, P.W. Lawrence Livermore National Lab., CA (United States). Mar 1993. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9306160–1: 6. international conference on soil dynamics and earthquake engineering, Bath (United Kingdom), 14-16 Jun 1993). Order Number DE93012313. Source: OSTI; NTIS; GPO Dep.

We are developing a methodology chain to estimate the response of structures to large earthquakes from specific faults. The methodology consists of three distinct steps: generation of synthetic bedrock motion at the site of the structure due to a postulated large earthquake; nonlinear effective stress analysis of the soil response at the site to transform bedrock motion to surface motion; and linear/nonlinear finite element analysis of the structure based on the predicted surface motions. Progress in all steps is reported here.

24182 (UCRL-JC–113083) **Demonstration of automated robotic workcell for hazardous waste characterization.** Holliday, M.; Dougan, A.; Gavel, D.; Gustaveson, D.; Johnson, R.; Kettering, B.; Wilhelmsen, K. Lawrence Livermore National Lab., CA (United States). Feb 1993. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE93008678. Source: OSTI; NTIS; INIS; GPO Dep.

An automated robotic workcell to classify hazardous waste stream items with previously unknown characteristics has been designed, tested and demonstrated The object attributes being quantified are radiation signature, metal content, and object orientation and volume. The multi sensor information is used to make segregation decisions plus do automatic grasping of objects. The work-cell control program uses an off-line programming system by Cimetrix Inc. as a server to do both simulation control as well as actual hardware control of the workcell. This paper will discuss the overall workcell layout, sensor specifications, workcell supervisory control, 2D vision based automated grasp planning and object classification algorithms.

24183 (UCRL-LR–113247) **The national machine tool partnership: Final report and recommendations of the Machine Tool Task Team.** Barlow, T.M. (Lawrence Livermore National Lab., CA (United States)); Law, D.A.; Plymale, D.L.; Williams, T.L. Lawrence Livermore National Lab., CA (United States). Apr 1993. 68p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE93012438. Source: OSTI; NTIS; GPO Dep.

This report describes the work of the Machine Tool Task Team, which was formed in June, 1992, by the US Department of Energy in response to a request by the National Security Advisor to the President, Brent Scowcroft, who asked the Department to "...examine which research and development efforts in the national laboratories could benefit the domestic machine tool industry and ... recommend appropriate investment and technology transfer to realize such benefit." The Team included representatives from the Lawrence Livermore, Los Alamos, and Sandia National Laboratories and the Oak Ridge Y-12 Plant. The report serves two purposes: (1) to further inform appropriate organizations and individuals concerning the status and trends in the US machine tool industry and (2) to describe a plan for a coordinated effort to strengthen both the infrastructure and the technological capabilities within the industry. The report includes two principal sections, in keeping with its dual purpose. Part I describes the Task Team's findings concerning the machine tool industry and summarizes several of the publicly funded programs that have been created to strengthen it over the past several years. It also briefly describes the needs of the industry that are not being met by these programs. Part III of the report describes the plan developed by the Task Team for "The National Machine Tool Partnership," a coordinated, federally funded program designed to take advantage of the technologies and technical capabilities that have been developed and deployed by the national laboratories and facilities.

24184 (WSRC-MS–92-408) **The need of coupled differential and integral spectral radiation measurements.** Zino, J.F. Westinghouse Savannah River Co., Aiken, SC (United States). [1993]. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE93014744. Source: OSTI; NTIS; INIS; GPO Dep.

The criticality safety community has historically directed a significant amount of effort toward attempting to quantify the integral behavior of fissioning systems via critical and subcritical experimental measurements. Some typical integral characteristics include critical masses, geometries, or concentrations for particular fissile isotopes in different chemical forms. While information such as this can be invaluable for determining criticality safety operating limits and for benchmarking computational methods, it is only a part of what is necessary for analyzing criticality accident alarm detectors. These analyses also require determination of the differential behavior of the leakage radiation (neutron and/or photon) emanating from the source, and an integral estimate of the corresponding detector dose response. This paper addresses part of the work done at the Savannah River Technology Center to validate version 4.2 of the Monte Carlo transport code MCNP for application to criticality detector response analysis. Additionally, the paper discusses some observations about existing experimental data which can be used for code validation, as well as the need for further experiments.

24185 (Y/DD–588) **Migration of nuclear criticality safety software from a mainframe to a workstation environment.** Bowie, L.J.; Robinson, R.C.; Cain, V.R. Oak Ridge Y-12 Plant, TN (United States). Jan 1993. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OS21400. (CONF-930601–14: American Nuclear Society (ANS) annual meeting, San Diego, CA (United States), 20-24 Jun 1993). Order Number DE93011838. Source: OSTI; NTIS; INIS; GPO Dep.

The Nuclear Criticality Safety Department (NCSD), Oak Ridge Y-12 Plant has undergone the transition of executing the Martin Marietta Energy Systems Nuclear Criticality Safety Software (NCSS) on IBM mainframes to a Hewlett-Packard (HP) 9000/730

workstation (NCSSHP). NCSSHP contains the following configuration controlled modules and cross-section libraries: BONAMI, CSAS, GEOMCHY, ICE, KENO IV, KENO Va, MODIIFY, NITAWL SCALE, SLTBLIB, XSDRN, UNIXLIB, albedos library, weights library, 16-Group HANSEN-ROACH master library, 27-Group ENDF/B-IV master library, and standard composition library. This paper will discuss the method used to choose the workstation, the hardware setup of the chosen workstation, an overview of Y-12 software quality assurance and configuration control methodology, code validation, difficulties encountered in migrating the codes, and advantages to migrating to a workstation environment.

24186 (Y/DV–1191) **Ultrasonic cleaning as a replacement for chlorinated solvents.** Thompson, L.M. (Martin Marietta Energy Systems, Inc., Oak Ridge, TN (United States)); Eichholtz, R.L. Oak Ridge Y-12 Plant, TN (United States). 12 Apr 1993. 14p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract AC05-84OS21400. (CONF-930647–4: 86. annual meeting and exhibition of the Air and Waste Management Association, Denver, CO (United States), 13-18 Jun 1993). Order Number DE93013253. Source: OSTI; NTIS; GPO Dep.

Chlorinated solvents have long been used in industry for cleaning purposes. These solvents were non-flammable, thought to be relatively of low toxicity, and worked. However, these solvents are now thought to cause environmental and health problems. Methyl chloroform (1,1,1-trichloroethane or TCA) and trichlorotrifluoroethane (CFC-113) are considered ozone depleting substances and are being regulated as such. The United States is a signatory to the Montreal Protocol and its amendments which call for a phase-out of the production of CFC-113 by the year 2000 and TCA by the year 2005. There is a move afoot to change these phase-out dates to December 31, 1995, although at this time there has been no official action taken. Other chlorinated solvents such as methylene chloride and perchloroethylene (perk) have been labeled as suspect carcinogens. Due to these health concerns, the Occupational Health and Safety Administration (OSHA) has issued proposals to lower the permissible exposure levels of these substances. All of these solvents are also considered Resource Conservation and Recovery Act (RCRA) wastes. Thus, the wastes must be handled under strict guidelines. Due to all of these concerns, finding alternatives for these solvents has become attractive. Personnel at the Martin Marietta Energy Systems Y-12 Plant in Oak Ridge, Tennessee, conducted numerous studies which investigated the use of ultrasonic cleaning with aqueous detergent as a substitute for vapor degreasing with chlorinated solvents. The first ultrasonic cleaner was installed in the plant in 1984 and numerous other cleaners have followed. Because of the success of this substitution program, personnel at the United States Army Environmental Center have funded a project to investigate the use of ultrasonics with aqueous detergent as a substitute for chlorinated solvents used in cleaning operations at the Army depots.

24187 (Y/DX–2150) **Enterprise Technologies Deployment for Agile Manufacturing.** Neal, R.E. Oak Ridge Y-12 Plant, TN (United States). Nov 1992. 25p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OS21400. Order Number DE93013257. Source: OSTI; NTIS; GPO Dep.

This report is intended for high-level technical planners who are responsible for planning future developments for their company or Department of Energy/Defense Programs (DOE/DP) facilities. On one hand, the information may be too detailed or contain too much manufacturing technology jargon for a high-level, nontechnical executive, while at the same time an expert in any of the four infrastructure fields (Product Definition/Order Entry, Planning and Scheduling, Shop Floor Management, and Intelligent Manufacturing Systems) will know more than is conveyed here. The purpose is to describe a vision of technology deployment for an agile manufacturing enterprise. According to the 21st Century Manufacturing Enterprise Strategy, the root philosophy of agile manufacturing is that "competitive advantage in the new systems will belong to agile manufacturing enterprises, capable of responding rapidly to demand for high-quality, highly customized products." Such agility will be based on flexible technologies, skilled workers, and flexible management structures which collectively will foster cooperative initiatives in and among companies. The remainder of this report is dedicated to sharpening our vision and to establishing a framework for defining specific project or pre-competitive project goals which will demonstrate agility through technology deployment.

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24188 (CONF-8810234–, pp. 7-19) **An experimental study of turbulent mixing by Rayleigh-Taylor instabilities and a two-fluid model of the mixing phenomena.** Andrews, M.J. (Princeton Univ., NJ (US)). Lawrence Livermore National Lab., CA (United States). 1 Jan 1992. From Workshop on the physics of compressible turbulent mixing; Princeton, NJ (United States); 24-27 Oct 1988. In *Advances in compressible turbulent mixing.* 634p. Order Number DE92014326. Source: OSTI; NTIS; INIS.

A simple experiment has been used to quantitatively investigate turbulent mixing at an unstable interface when the interface is subject to a large two-dimensional disturbance. The introduction of a small amplitude long wavelength does little to alter the early time development of a planar mixed region, but at late times causes a large overturning motion that tends to thin the planar mixed region and accelerate the overall mixing process. Data have been collected from the experiment by way of image analysis of experimental photographs. These data serve as a source of information for the development of a "two-fluid" model of the mixing process. A "two-fluid" model has been developed to describe the turbulent mixing by Rayleigh-Taylor instabilities of the two different density fluids investigated in the experimental study above. A one-dimensional model was employed for the planar mixing experiments; here attention is focused on the development of a physically plausible equation to describe the length-scale development within the mixed region. The one-dimensional model was then extended to two-dimensions for the overturning experiments, and terms are added to account for thinning of the mixing region at late times. Data collected from the experiments are used to validate the model and to determine several model constants. The two-fluid model successfully simulates the experimental results and is recommended for further application to turbulent mixing processes in buoyant environments.

24189 (CONF-8810234–, pp. 21-37) **Compressibility influences on boundary-layer transition.** Bushnell, D.M. (NASA Langley Research Center, Hampton, VA (US)); Malik, M.R. Lawrence Livermore National Lab., CA (United States). 1 Jan 1992. From Workshop on the physics of compressible turbulent mixing; Princeton, NJ (United States); 24-27 Oct 1988. In *Advances in compressible turbulent mixing.* 634p. Order Number DE92014326. Source: OSTI; NTIS; INIS.

Paper briefly summarizes the influences of increasing Mach number upon the various stages of boundary-layer transition including body flow field processing of incident stream disturbances and normal mode amplification. Other compressibility unique or altered phenomena discussed include (a) outward movement of the critical layer and the related "precursor" transition, (b) flow chemistry, (c) shock waves, and (d) the all pervasive roughness issue. Paper concludes with consideration of ground simulation and prediction of high-speed transition.

24190 (CONF-8810234–, pp. 39-50) **Quasisymmetry of flows and chaos of streamlines.** Chernikov, A.A. (Space Research Institute, Moscow (RU)); Sagdeev, R.Z.; Zaslavsky, G.M. Lawrence Livermore National Lab., CA (United States). 1 Jan 1992. From Workshop on the physics of compressible turbulent mixing; Princeton, NJ (United States); 24-27 Oct 1988. In *Advances in compressible turbulent mixing.* 634p. Order Number DE92014326. Source: OSTI; NTIS; INIS.

The onset of turbulence may be preceded by development of ordered spatial structures. Such structures play a prominent role in mixing and advection processes. Presence of these structures can lead to chaotic spatial distribution of streamlines and to random walk of passive particles along the streamlines. Examples of such particle mixing are well known, they are the ABC-flow, and the flow between rotating cylinders. In connection with these phenomena

some general questions arise concerning the structural mixing: (1) which kinds of structures are admissible; (2) which structures can lead to mixing of streamlines; (3) what are the laws of transport of passive particles? Here we discuss the first two questions which are tightly connected with modern problems of nonlinear dynamics. The part of the paper devoted to symmetry of the structures is restricted to incompressible flows. This provides the simplest way to deduce possible types of flow organization. We further restrict ourselves to the Beltrami-type flows. Special interest in such flows is associated with instability of large-scale modes obeying the Beitrami condition in fluids with strongly developed turbulence. It is plausible that extended regions occupied by Beltrami flows can be present in turbulent flows. It is possible to say that flows can be "beltramized." We have shown that stationary hydrodynamic Beltrami flows can possess an arbitrary symmetry of quasi-crystallic type. Not withstanding the regular character of the structures, the flow also includes elements of irregularity, stochasticity. In some regions of space, the streamlines are distributed chaotically. The concluding part of the paper is devoted to chaos of streamlines in stationary Rayleigh-Benard convection. It is shown that three-dimensional stationary flow with hexagonal cells produces a spatial web of finite thickness within which the chaotic streamlines are concentrated.

24191 (CONF-8810234–, pp. 51-60) **Evolution of the laser ablatively driven Rayleigh-Taylor mix layer.** Emery, M.H. (Naval Research Laboratory, Washington, DC (US)); Gardner, J.H. Lawrence Livermore National Lab., CA (United States). 1 Jan 1992. From Workshop on the physics of compressible turbulent mixing; Princeton, NJ (United States); 24-27 Oct 1988. In *Advances in compressible turbulent mixing.* 634p. Order Number DE92014326. Source: OSTI; NTIS; INIS.

The Rayleigh-Taylor (RT) instability occurs whenever a dense fluid is accelerated by a fluid of lower density. Perturbations on the interface between the two fluids are predicted to grow exponentially in time with a growth rate $\gamma = (Akg)^{\frac{1}{2}}$, where the Atwood number $A = (\rho h - \rho l)/(\rho h+\rho l)$, ρh (ρl) is the density of the heavy (light) fluid, the wavenumber $k = 27\pi/\lambda$, λ is the wavelength of the perturbation and g is the acceleration. When the amplitude of the perturbation (η) becomes of order of $\lambda/2\pi$, the sinusoidal surface disturbance mutates to rounded columns of "light" fluid rising into the "heavy" fluid which, in turn, is funneled downward. This is the classical bubble-and-spike structure. It is at about this amplitude that the RT exponential growth transitions into a nonlinear "free-fall" regime. The evolution of the bubble (spike) is now well described $\eta b=\alpha b gt^2/2$ ($\eta s=\alpha s gt^2/2$, where $\eta b(\eta s)$ is the amplitude of the bubble (spike) and αb (αs) is the free-fall reduction factor for the bubble (spike). Typically $\alpha b \leq 1$. In addition, the velocity of the bubble rise is $\propto (g\lambda)^{\frac{1}{2}}$). Thus for classical, incompressible RT in the presence of in any perturbation wavelengths, the shortest wavelength modes will grow the fastest, saturate the earliest and then the larger bubbles will subsume the smaller bubbles and larger and larger structures will dominate the flow. This tendency for the bulk of the energy to concentrate in the long wavelength modes means that fluid elements with like signed vorticity must tend to group together; in no other way is it possible for the scale of the velocity distribution to increase.

24192 (CONF-8810234–, pp. 61-73) **Similarity theory of incompressible random Rayleigh-Taylor instability.** Freed, N. (NRCN, Beer-Sheva (IL)); Ofer, D.; Shvarts, D.; Orszag, S.A. Lawrence Livermore National Lab., CA (United States). 1 Jan 1992. From Workshop on the physics of compressible turbulent mixing; Princeton, NJ (United States); 24-27 Oct 1988. In *Advances in compressible turbulent mixing.* 634p. Order Number DE92014326. Source: OSTI; NTIS; INIS.

In this Note, we show how a detailed analysis of recent high resolution two-dimensional numerical simulations of low Mach number (incompressible) random Rayleigh-Taylor instability allows the formulation and explicit perturbative solution of a mathematical model that embodies key features of these flows. The results are in good agreement with both the numerical simulations and with experiment. Some typical interfacial contours from the numerical simulations of Rayleigh-Taylor instability at density ratios $\alpha = 2 : 3{,}1 : 3{,}1 : 20$ [(Atwood ratios $A = (1 - \alpha)/(1 + \alpha)$ of 1/5, 1/2, 19/21, respectively)] are given in Figure 1; the numerical results are obtained using an ALE (Arbitrary Lagrangian-Eulerian) compressible flow code, supplemented by a novel and accurate interface tracking scheme, at a spatial resolution of 200x200 cells (run on a superworkstation).

24193 (CONF-8810234–, pp. 75-84) **Pseudo-spectral numerical simulations of sub and supersonic compressible viscous flows.** Gauthier, S. (Centre d'Etudes de Limeil-Valenton, Villeneuve (FR)). Lawrence Livermore National Lab., CA (United States). 1 Jan 1992. From Workshop on the physics of compressible turbulent mixing; Princeton, NJ (United States); 24-27 Oct 1988. In *Advances in compressible turbulent mixing.* 634p. Order Number DE92014326. Source: OSTI; NTIS; INIS.

Stability and transition to turbulence have been the object of a considerable interest in the past fifteen years. However, the mechanism by which a flow becomes chaotic has been studied, essentially, for thermal convection of incompressible fluids. Numerical simulations of such flows are usually carried out with the spectral methods owing to their high accuracy. In some situations, for example in stellar convection or in laser driven fusion, the stratification of the fluid can no longer be ignored and we have to use the full Navier-Stokes equations. Since the pioneering work of Graham, some papers have been devoted to the simulation of compressible convection. In the special case of fixed heat flux Yamaguchi found supersonic solutions even at low Rayleigh numbers. From a numerical point of view, viscous compressible flows involve very different time scales which lead to long time runs. A Fourier expansion is used in the horizontal direction. The expansion in the Chebyshev polynomials used in the inhomogeneous direction leads to severe time step constraints due to the high resolution on the boundaries. However, in compressible flows, viscous and thermal diffusion terms are nonlinear. This nonlinearity leads to use iterative methods such as suggested by Orszag. In the first version of the code, only vertical diffusion terms were solved implicitly by an iterative method preconditioned by the time independent Chebyshev approximation of the diffusion operator. In this paper we present a more implicit version where convective terms are treated simplicity and all diffusion terms are handled with an iterative method preconditioned by the finite difference approximation of the diffusion operator. We used both numerical schemes to compute sub and supersonic steady state solutions obtained with radiative boundary conditions.

24194 (CONF-8810234–, pp. 85-93) **Statistical theories of Rayleigh-Taylor instability for compressible fluids.** Glimm, J. (New York Univ., NY (US)); Li, X.L.; Zhang, Q.; Menikoff, R.; Sharp, D. Lawrence Livermore National Lab., CA (United States). 1 Jan 1992. Grant DMS-83-1229. From Workshop on the physics of compressible turbulent mixing; Princeton, NJ (United States); 24-27 Oct 1988. In *Advances in compressible turbulent mixing.* 634p. Order Number DE92014326. Source: OSTI; NTIS; INIS.

Statistical theories for the outer envelope of the Rayleigh-Taylor mixing layer refer to a simplified dynamics of fundamental modes and their interactions. These modes are bubbles of light fluid entrained in the mixing layer between the undisturbed light and heavy fluids. The dynamics can be understood in terms of the motion of a single mode and the interactions between modes. The single mode dynamics has to be solved self-consistently in a background field of random bubbles. The dominant interaction is bubble merger, i.e. the spreading of larger bubbles at the bubble envelope. Merger leads to dynamically increasing length scales, and thus to a dynamic renormalization of scaling dimensions. The mechanism for bubble merger is the differential motion of physically adjacent single bubble modes. This paper is focused on the above topics: single bubble motion, bubble interactions and statistical models.

24195 (CONF-8810234–, pp. 95-104) **Molecular mixing in Rayleigh-Taylor instability.** Linden, P.F. (Univ. of Cambridge (GB)); Redondo, J.M.; Caulfield, C.P. Lawrence Livermore National Lab., CA (United States). 1 Jan 1992. From Workshop on the physics of compressible turbulent mixing; Princeton, NJ (United States); 24-27 Oct 1988. In *Advances in compressible turbulent mixing.* 634p. Order Number DE92014326. Source: OSTI; NTIS; INIS.

The amount of mixing at the molecular level at various stages during the growth of Rayleigh-Taylor instability is investigated in a

series of laboratory experiments. Instability is produced at an interface between two miscable liquids, brine and fresh water, with zero surface tension. The brine, density $\rho + \Delta\rho$ with $\Delta\rho > 0$, is placed on top of a layer of fresh water, density ρ, and separated from it by a horizontal barrier. Both liquid layers are initially at rest, and the instability is initiated by removing the barrier horizontally. Measurements consist of visual observations of the flow using fluorescent dye and shadow-graphs. Quantitative measurements of the amount of mixing are obtained from analysis of dye intensities profiles during the growth of the instability. These measurements give an integrated value (across the width of the mixing region) of the amount of mixing. A conductivity probe has been used to make point measurements of the salinity. These have been correlated with visual observations of relate changes in salinity with specific mixing processes.

24196 (CONF-8810234–, pp. 105-116) **Is a laminar flame front a passive surface of the turbulent field?.** Mantzaras, J. (Princeton Univ., NJ (US)); Felton, P.G.; Bracco, F.V. Lawrence Livermore National Lab., CA (United States). 1 Jan 1992. From Workshop on the physics of compressible turbulent mixing; Princeton, NJ (United States); 24-27 Oct 1988. In *Advances in compressible turbulent mixing.* 634p. Order Number DE92014326. Source: OSTI; NTIS; INIS.

The three-dimensional structure of the turbulent flame in premixed propane/air charges was examined by visualizing simultaneously four parallel planar sections through the flame with a time resolution of 10 ns and a spatial resolution as low as 200 ϕm. The ratio of the turbulent intensity u' to the laminar flame speed S_l ranged from 0.5 to 25 and the ratio of the Kolmogorov length scale to the laminar flame thickness from 0.2 to 5. The interface between reactants and products is: highly wrinkled; continuous; without islands of reactants and products; with only few cusps; with some "fingers" of products; and of fractal geometry. The fractal dimension increases with u'/S_l but seems to tend to a maximum value of about 2.38. This is also the value measured in non-reacting turbulent flows, thus suggesting that the interface between reactants and products may act as a constant property passive scalar surface under certain conditions. If the local and instantaneous turbulent flame speed is related to the fractal dimension, then significant inhomogeneities in this speed are found even though the turbulent field is rather homogeneous and isotropic.

24197 (CONF-8810234–, pp. 117-124) **The stability of vortex arrays.** Saffman, P.G. (California Institute of Technology, Pasadena (US)). Lawrence Livermore National Lab., CA (United States). 1 Jan 1992. From Workshop on the physics of compressible turbulent mixing; Princeton, NJ (United States); 24-27 Oct 1988. In *Advances in compressible turbulent mixing.* 634p. Order Number DE92014326. Source: OSTI; NTIS; INIS.

The seminal observations by Brown & Roshko (1974) of large scale coherent structures in the turbulent mixing layer have stimulated large amounts of work on the question of the extent to which turbulent flows can be modelled by inviscid laminar dynamics. We wish to know if such modelling can lead to quantitative predictions as well as provide qualitative insights into the mechanisms of the evolution of the turbulent flows. The jury is still out on this question, and more problems have been raised than have been solved, but whatever the final conclusions, there is no doubt that a significant increase in the understanding of vortex dynamics has resulted from the effort. As an aside, it is said that the eye of the artist can see deeper into nature than the trained scientist. The drawings by Leonardo da Vinci of coherent structures and van Gogh's painting "Starry Night", which resembles closely the pairing process of coherent structures in the mixing layer, illustrate this adage.

24198 (CONF-8810234–, pp. 127-136) **Vortex formation in the wake of a flat plate for subsonic and supersonic freestream mach numbers.** Althaus, W. (Aerodynamisches Institut RWTH Aachen (DE)); Limberg, W.; Krause, E. Lawrence Livermore National Lab., CA (United States). 1 Jan 1992. From Workshop on the physics of compressible turbulent mixing; Princeton, NJ (United States); 24-27 Oct 1988. In *Advances in compressible turbulent mixing.* 634p. Order Number DE92014326. Source: OSTI; NTIS; INIS.

The interaction of a straight oblique shock with a supersonic turbulent wake of a flat plate was studied experimentally by means of Laser-Doppler-Anemometry and Mach-Zehnder interferometry. Investigated were the changes of the time-averaged velocity, the Reynolds stresses, the turbulence intensity across the shock and instantaneous density profiles. After completion of the experiments with a smooth plate, the investigation was extended to flows about flat plates with rough surfaces. The roughening of the surfaces was achieved by pasting sandpaper on to both sides of the plate. It was found that a detectable vortex street was formed in the wake in subsonic and supersonic flow, if the following three conditions are met: First, the relative roughness had to exceed a certain critical value, second, the trailing edge had to be sharp, i.e. no rounded corners, and third, the sandpaper should not extend to the trailing edge, but should end at a certain distance upstream from it. In a second series of experiments the shedding frequency was measured with Laser-Schlieren optics and the density drop in the vortex cores was evaluated with holographic interferometry in two wind tunnels. In addition, the time averaged velocity profiles were measured as before for undisturbed and shock-disturbed flow. The comparison of the results is discussed in this paper. Finally, an attempt was made to explain the formation of the vortex street in terms of absolute and convective instability. In order to do so, the Raleigh-equation was solved on the basis of time-averaged velocity profiles, measured in the near wake. First results indicate that the predicted Strouhal number is in rather close agreement with the one observed in the corresponding experiment.

24199 (CONF-8810234–, pp. 137-159) **Compressibility in turbulence generation and mixing.** Boris, J.P. (Naval Research Lab., Washington, DC (US)). Lawrence Livermore National Lab., CA (United States). 1 Jan 1992. From Workshop on the physics of compressible turbulent mixing; Princeton, NJ (United States); 24-27 Oct 1988. In *Advances in compressible turbulent mixing.* 634p. Order Number DE92014326. Source: OSTI; NTIS; INIS.

This paper considers some of the physical mechanisms by which fluid compressibility causes the generation of turbulence and affects turbulent mixing. All fluid velocity fields are composed of a rotational component, the curl of the velocity, a compressional component, the divergence of the velocity, and a potential component which is both curl and divergence free. In studying the physics of compressibility in turbulent mixing, different situations are distinguished by categorizing not only the curl and divergence currently in the flow but also by the existence of other properties induced by the prior effects of both rotation and compression. In this paper I will use the term "passive" to describe the integrated effects of prior compressibility which is currently influencing the flow from "active" compressibility effects stemming from compression or expansion accelerations occurring dynamically in the system. These active and passive compressional interactions with rotational flow feed on each other in a dynamic three-stage cycle where fluid dynamic instabilities cascade through spatial and spectral scales to create a very complex flow field. These convoluted surfaces in turn enhance molecular diffusion and transport between the separate materials, thus changing the overall energy balance in the system. This changed energy balance, in turn feeds back into the fluid dynamic channels of instability, closing the cycle. In our earlier work involving compressible systems, these passive and active roles of compressibility were encountered primarily in the context of reactive flows with turbulence. Combustion, reactive shocks and detonation, as sources of strong and rapid compressibility effects, naturally are associated with compressible turbulence, empowering such relatively passive expansion-driven phenomena as bouyancy and vortex bursting as well as the more active, shock-driven situations.

24200 (CONF-8810234–, pp. 161-170) **Inviscid simulations of turbulent shear layers - mean flow analysis.** Chien, K.Y. (Naval Surface Warfare Center, Silver Spring, MD (US)); Ferguson, R.E.; Kuhl, A.L.; Glaz, H.M.; Colella, P. Lawrence Livermore National Lab., CA (United States). 1 Jan 1992. From Workshop on the physics of compressible turbulent mixing; Princeton, NJ (United States); 24-27 Oct 1988. In *Advances in compressible turbulent mixing.* 634p. Order Number DE92014326. Source: OSTI; NTIS; INIS.

Effects of density and velocity variations between two streams of an unconfined, spatially-developing shear layer are studied by numerical solutions of the time-dependent Euler equations using a second-order Godunov scheme. The inviscid calculations duplicate quite well the major flow features that have been observed in the experiments of Brown and Roshko and of Oster and Wygnanski. These include the visual spreading rates and the mean-flow velocity and density profiles. This study suggests then that the mean-flow evolution is dominated by two-dimensional, inviscid effects.

24201 (CONF-8810234–, pp. 171-181) **Application of a two-equation turbulence mix model.** Crowley, W.P. (Lawrence Livermore National Lab., CA (US)). Lawrence Livermore National Lab., CA (United States). 1 Jan 1992. From Workshop on the physics of compressible turbulent mixing; Princeton, NJ (United States); 24-27 Oct 1988. In *Advances in compressible turbulent mixing.* 634p. Order Number DE92014326. Source: OSTI; NTIS; INIS.

A mass averaged k-epsilon model was derived by Leith using a moment expansion and appropriate closure models. Moving the mesh with the mass averaged velocity results in a Lagrangian model with constant mass in each zone. In this paper Leith's model is transformed into an "Almost Lagrangian" model by taking the mesh velocity to be the ensemble averaged fluid velocity. Here the mass in each zone may change with time. The resulting 1-D model is used to simulate the Smits and Muck supersonic wind tunnel experiment in which preexisting turbulence is amplified by a shock wave. From the model results we deduce a simplified k-ε model that is applicable to the Smits and Muck (S&M) experiment. In the analytic solution for the simplified model we find the shock thickness to be increased by a factor of 105; behind the shock the turbulent energy decays as t^{-1}.

24202 (CONF-8810234–, pp. 183-192) **A numerical study of inviscid, supersonic mixing layers.** Eberhardt, S. (Univ. of Washington, Seattle (US)); Riley, J.J.; Soetrisno, M.; Greenough, J.A. Lawrence Livermore National Lab., CA (United States). 1 Jan 1992. Contract N00014-87-K-0174. From Workshop on the physics of compressible turbulent mixing; Princeton, NJ (United States); 24-27 Oct 1988. In *Advances in compressible turbulent mixing.* 634p. Order Number DE92014326. Source: OSTI; NTIS; INIS.

The purpose of this research is to understand the physical processes associated with turbulent mixing in supersonic shear layers. Specifically, the evolution of instabilities in two and three-dimensional, confined and unconfined, temporal shear layers are studied. Both linear stability theory and direct numerical simulation are used. For the two-dimensional, supersonic, confined layer, two distinct modes of instability are found, a symmetric and an asymmetric mode. In both cases the instability grows nonlinearly with large amplitude disturbances that never roll up like the classical Kelvin-Helmholtz instability. Another mode of instability is found for the confined, transonic layer where a higher mode is excited from a nonlinear interaction of the walls with the fundamental mode. The most unstable modes for the three-dimensional layer at supersonic relative Mach numbers is purely three-dimensional, i.e. oblique to the flow direction.

24203 (CONF-8810234–, pp. 193-202) **Simulation of shock and vortex interactions.** Ellzey, J.L. (Berkeley Research Associates, Springfield, VA (US)); Oran, E.S. Lawrence Livermore National Lab., CA (United States). 1 Jan 1992. From Workshop on the physics of compressible turbulent mixing; Princeton, NJ (United States); 24-27 Oct 1988. In *Advances in compressible turbulent mixing.* 634p. Order Number DE92014326. Source: OSTI; NTIS; INIS.

Previous experimental and theoretical studies have shown that unstable subsonic shear layers evolve into a pattern of large-scale vortices which engulf fluid as they rotate in the flow field. In many cases, these large vortices break down even further due to conditions in the flow that allow new instabilities to develop. This convective mixing process is particularly important in combustors in which ignition of the premixed gases depends upon adequate mixing of the hot and cold fluids. In supersonic mixing layers, the structure of the shear layer can resemble what we see in subsonic mixing layers if the relative Mach number between the two layers is subsonic. However, the presence of shock waves may have a significant effect on the vortices and on the large-scale mixing process.

24204 (CONF-8810234–, pp. 203-216) **Mixing patterns and the generation of vorticity in a density stratified shear layer.** Ghoniem, A.F. (Massachusetts Institute of Technology, Cambridge (US)); Krishna, A. Lawrence Livermore National Lab., CA (United States). 1 Jan 1992. From Workshop on the physics of compressible turbulent mixing; Princeton, NJ (United States); 24-27 Oct 1988. In *Advances in compressible turbulent mixing.* 634p. Order Number DE92014326. Source: OSTI; NTIS; INIS.

Numerical solutions of the unsteady inviscid, two-dimensional vorticity and mass conservation equations for an incompressible density-stratified flow in a Lagrangian, grid-free form are used to investigate the effects of vorticity generation due to baroclinicity on the development of the Kelvin-Helmholtz (K-H) instability beyond the linear range. Continuous, although sharply-decaying, density stratification is considered, and large overall density ratios are assumed. Solutions are also obtained for the corresponding linear stability problem and are used to complement the numerical solution within the initial stages of the instability. Results show that the generation of baroclinic vorticity due to the acceleration of fluid elements in a non-uniform density field imparts certain asymmetry on the structures that develop due to the K-H instability. This asymmetry is associated with the convective motion of the structure in the direction of the heavy fluid but towards the light fluid, and causes a bias in the composition of the fluid within the structure towards the light fluid.

24205 (CONF-8810234–, pp. 217-225) **Vortex shedding and merging in high-speed confined shear flows.** Kailasanath, K. (Naval Research Lab., Washington, DC (US)); Gardner, J.H.; Oran, E.S.; Boris, J.P. Lawrence Livermore National Lab., CA (United States). 1 Jan 1992. From Workshop on the physics of compressible turbulent mixing; Princeton, NJ (United States); 24-27 Oct 1988. In *Advances in compressible turbulent mixing.* 634p. Order Number DE92014326. Source: OSTI; NTIS; INIS.

We describe a series of numerical simulations of a confined axisymmetric jet in which the inflow Mach number is varied, but the geometry and properties of the gas are held fixed. Of particular interest is how the acoustic-vortex interactions change as the inflow velocity varies from 50 to 300 m/s, corresponding to Mach numbers from 0.15 to close to one. When the velocity is increased, the natural instability frequency of the shear layer increases. If the gas properties and the geometry of the system are fixed, the acoustic frequencies remain essentially the same. Thus by varying the inflow velocity, we can examine the coupling between the acoustics and the flow instabilities. We find that when a dominant acoustic frequency is near the natural instability frequency, the shear layer first rolls up at the acoustic frequency. However, when these frequencies are very different, the shear layer rolls up at the natural instability frequency. In all cases, the acoustic frequencies strongly affect the downstream vortex mergings.

24206 (CONF-8810234–, pp. 227-236) **Extension of second-moment turbulence models in cases with large density non-uniformity.** MacInnes, J.M. (Princeton Univ., NJ (US)). Lawrence Livermore National Lab., CA (United States). 1 Jan 1992. From Workshop on the physics of compressible turbulent mixing; Princeton, NJ (United States); 24-27 Oct 1988. In *Advances in compressible turbulent mixing.* 634p. Order Number DE92014326. Source: OSTI; NTIS; INIS.

The paper provides an assessment of the turbulence modeling of incompressible non-reacting flows and focuses on the main physical processes associated with the density non-uniformity in such cases. Experimental evidence from plane mixing layers under various conditions is used to deduce some controlling mechanisms and to arrive at a proposed modeling to represent those mechanisms.

24207 (CONF-8810234–, pp. 237-246) **Instantaneous velocity profiles and density cross sections in supersonic shear layers.** Miles, R. (Princeton Univ., NJ (US)); Smits, A.; Markovitz, E.; Connors, J.; Roth, G.; Howard, P.; Smith, M.; Kumar, V.; Lempert, W. Lawrence Livermore National Lab., CA (United States). 1 Jan 1992. From Workshop on the physics of compressible turbulent mixing; Princeton, NJ (United States); 24-27 Oct 1988. In

Advances in compressible turbulent mixing. 634p. Order Number DE92014326. Source: OSTI; NTIS; INIS.

A new method of nonintrusive diagnostics in air based on vibrational excitation of oxygen, laser-induced fluorescence and Rayleigh scattering, is applied to a supersonic axisymmetric free jet and a supersonic Mach 3 boundary layer to generate instantaneous velocity profiles and density cross sections. The velocity profiles give a quantitative measure of the velocity across the jet at any location downstream of the nozzle exit. Numerous such images are taken at several locations to generate average velocity profiles as well as turbulence intensity and axial velocity correlations across the turbulent free shear layer. Simultaneous Rayleigh scattering gives a two-dimensional cross section of the density. In the boundary layer, Rayleigh scattering is used to generate instantaneous density cross sections, two-dimensional density correlations, and probability density distribution functions of the density. This new measurement technique introduces a promising method to make quantitative comparisons with computational models.

24208 (CONF-8810234–, pp. 247-256) **Numerical simulation of the formation of vortex streets in a compressible fluid.** Munz, C.D. (Kernforschungszentrum Karlsruhe (DE)); Schmidt, L.; Schoeffel, S. Lawrence Livermore National Lab., CA (United States). 1 Jan 1992. From Workshop on the physics of compressible turbulent mixing; Princeton, NJ (United States); 24-27 Oct 1988. In *Advances in compressible turbulent mixing.* 634p. Order Number DE92014326. Source: OSTI; NTIS; INIS.

The mechanism of the formation of vortex streets in the wake of a bluff body can be studied by considering the interaction of two infinite vortex sheets which are initially a fixed distance apart. This idea was conceived by Abernathy and Kronauer who, by this consideration succeeded in explaining essential features of the mechanism in an inviscid incompressible fluid. In this paper, we take up this idea in order to study the formation of vortex streets in a compressible fluid at different Mach numbers. This done by direct numerical simulations based on the two-dimensional compressible Navier-Stokes equations. To follow the development of the vortex sheets we combined the numerical simulation of the flow field with a marker particle algorithm At the beginning of our calculations the vortex sheets are marked by a set of particles. They are advected during the calculation in a Lagrangean fashion according to the calculated flow field. The formation of the vortex street is then visualized by graphically displaying these marker particles, similar to streaklines in experiments. While in practice flows usually develop streamwise, in our numerical calculations we assume two infinite vortex sheets which are periodically disturbed in space and the results show the development of vortex streets in time. This flow model enables us to perform large-scale computations with good resolution and the solution does not leave the computational domain.

24209 (CONF-8810234–, pp. 257-263) **Outstanding issues in the area of compressible mixing.** Papamoschou, D. (California Institute of Technology, Pasadena (US)). Lawrence Livermore National Lab., CA (United States). 1 Jan 1992. From Workshop on the physics of compressible turbulent mixing; Princeton, NJ (United States); 24-27 Oct 1988. In *Advances in compressible turbulent mixing.* 634p. Order Number DE92014326. Source: OSTI; NTIS; INIS.

Issues that arose from the experimental investigation of the turbulent compressible shear layer in a variable-gas, variable-Mach number facility are explored. In that investigation, the growth rates were correlated with the convective Mach number M_c, i.e., the Mach number in the frame of reference of the large-scale structure. Initially, M_c was obtained theoretically, using arguments which give it approximately the same value on the two sides of the layer. The growth rate, normalized by its incompressible value, versus M_c falls on a universal curve that decreases with M_c I Implications of that curve, as well as possible intuitive scenarios for the growth-reduction mechanism, are discussed. Recent double-exposure photos of the flow reveal that, at high compressibility, M_c has substantially different values on the two sides of the layer. Reasons for this difference between experiment and theory are suggested. The effect of the walls and the possible three-dimensionality of the flow are identified as open questions whose resolution is very important.

24210 (CONF-8810234–, pp. 265-269) **Effect of particulate additives on heat transfer from a shock-induced turbulent boundary layer.** Roberts, G.T.; East, R.A.; Pratt, N.H. Lawrence Livermore National Lab., CA (United States). 1 Jan 1992. From Workshop on the physics of compressible turbulent mixing; Princeton, NJ (United States); 24-27 Oct 1988. In *Advances in compressible turbulent mixing.* 634p. Order Number DE92014326. Source: OSTI; NTIS; INIS.

Evidence exists that significant reductions in gun barrel wall heat flux (and heat extension of the barrel life) can be effected by adding particulate matter to the non-steady, turbulent boundary layer which develops behind the moving projectile. The mechanisms causing the heat transfer reduction are uncertain but may be related to the phenomenon, noted in incompressible turbulent boundary layer flows, where additives (either in the form of long chain molecules of length comparable to the Kolmogorov scale of turbulence in the case of water flows, or solid particulates in the case of gaseous flows) reduce the wall skin friction. In order to investigate further the heat flux reduction phenomenon, the present work was undertaken to measure the wall heat flux from a non-steady, turbulent boundary layer in a shock tube, where the freestream Mach number was supersonic and the wall was initially coated with a thin layer of talc particles of mean diameter D = 4.5ϕm.

24211 (CONF-8810234–, pp. 271-277) **Periodic slot blowing of a supersonic turbulent boundary layer.** Selig, M.S. (Princeton Univ., NJ (US)); Smits, A.J.; Fernando, E.M. Lawrence Livermore National Lab., CA (United States). 1 Jan 1992. From Workshop on the physics of compressible turbulent mixing; Princeton, NJ (United States); 24-27 Oct 1988. In *Advances in compressible turbulent mixing.* 634p. Order Number DE92014326. Source: OSTI; NTIS; INIS.

The present investigation was initiated to help improve our understanding of unsteady shock-wave/boundary layer interactions, with the specific aim of determining the effect of the unsteady shock movement on the boundary layer turbulence. An unsteady shock-wave/boundary-layer interaction was produced on a flat plate by introducing periodic blowing through a spanwise slot in the wall at frequencies up to 5kHz. The incoming flow conditions were M_∞ - 2.84, Re_∞/l - 6.5 x 10^7, and δo - 26 mm. Measurements of the fluctuating mass flux and wall pressure were made, and the unsteady flowfield was visualized through stroboscopic schlieren videography. Since the blowing was periodic, phase-averaging could be used to identify the downstream effect of the shock oscillation. The results suggest that the main effect of the unsteady shock motion is to displace the incoming boundary layer flow without affecting the turbulence levels significantly. More interestingly, the speed of the upstream and downstream shock movement was found to be only a small fraction of the freestream velocity, and it was not strongly affected by the amount of blowing, or by the frequency of blowing.

24212 (CONF-8810234–, pp. 279-288) **Compressible, fully de-aliased, two-dimensional spectral method simulations of fluid and magneto-fluid turbulence.** Shebalin, J.V. (NASA Langley Research Center, Hampton, VA (US)); Montgomery, D. Lawrence Livermore National Lab., CA (United States). 1 Jan 1992. From Workshop on the physics of compressible turbulent mixing; Princeton, NJ (United States); 24-27 Oct 1988. In *Advances in compressible turbulent mixing.* 634p. Order Number DE92014326. Source: OSTI; NTIS; INIS.

A fully de-aliased, two-dimensional Fourier spectral method simulation is described. This numerical method is used to study the spectral distribution of relative compressible and magnetic energy versus initial rms Mach number for decaying turbulence. Results from fluid (Navier-Stokes) simulations are compared with magneto-fluid (MHD) simulations. Future applications of the numerical procedure are also discussed.

24213 (CONF-8810234–, pp. 289-298) **Euler equation of one-dimensional compressible gas and locally-equilibrium molecular dynamics.** Sinai, Y.G. (Landau Institute of Theoretical Physics, Moscow (RU)). Lawrence Livermore National Lab., CA (United States). 1 Jan 1992. From Workshop on the physics of compressible turbulent mixing; Princeton, NJ (United States); 24-27 Oct 1988. In *Advances in compressible turbulent mixing.* 634p. Order Number DE92014326. Source: OSTI; NTIS; INIS.

The problem which we intend to consider in this talk can be described as the study of relations between microscopical properties of matter and their macroscopical manifestation. One of the final goals, which is still unfortunately very far from us, is to understand whether turbulent motions may be thought as collective motions of some modes having a thermodynamic origin. We shall make several speculations about this at the end of this talk. The matter which we shall deal with here is classical. It means that we neglect quantum effects. This seems to be reasonable for normal thermodynamic conditions. Another restriction which we impose is more serious. We intend to consider only one-dimensional gases but we shall take into account their properties of compression and heat conductivity. The advantage or disadvantage of the one-dimensional systems is due to the fact that the local changes of form of the infinitesimal volumes are also one-dimensional, i.e., they are reduced only to the change of the scale but not to the change of form which does not even exist in the one-dimensional situation.

24214 (CONF-8810234–, pp. 299-310) **The structure of supersonic turbulent boundary layers: What we know and what we think we know.** Smits, A.J. (Princeton Univ., NJ (US)). Lawrence Livermore National Lab., CA (United States). 1 Jan 1992. Grant 88-0120. From Workshop on the physics of compressible turbulent mixing; Princeton, NJ (United States); 24-27 Oct 1988. In *Advances in compressible turbulent mixing.* 634p. Order Number DE92014326. Source: OSTI; NTIS; INIS.

A considerable amount of turbulence data has been obtained in supersonic boundary layer flows. Virtually all data up to 1980 which could be considered "functionally complete" that is, well-documented, were compiled by Fernholz and Finley (1980), and this listing was recently brought up to date by Fernholz et al. (1988). Measurements of $\langle u' \rangle$, $\langle (\phi u)' \rangle$ and $\langle T' \rangle$ are widely available, but unfortunately measurements of $\langle v' \rangle$ and $-u'v'$ are not. Even more unfortunately, few measurements of higher order moments have been made, and spectral data, probability density distributions, and correlations have only been obtained in very few cases. In this respect, the most complete data sets for zero pressure gradient flat plate boundary layers are those by Owen and Horstman (1972), Owen, Horstman and Kussoy (1975), Robinson (1986), Fernando (1988), Spina (1988) and Smits et al. (1988). In the present contribution, we present a review of this work to assess the significance of variable density on the structure of high speed turbulent boundary layers. For the purpose of comparison with the subsonic case we use the results from Alving (1988) because of the wide variety of data obtained in that flow. The flow conditions for all cases are summarized in Table I. Not all quantities were measured by every investigator, and therefore it is not always possible to make a clear distinction between Mach and Reynolds number effects.

24215 (CONF-8810234–, pp. 311-321) **Navier-Stokes simulation of supersonic free shear layer flows.** Tang, W. (Georgia Institute of Technology, Atlanta (US)); Sankar, L.N.; Komerath, N.M. Lawrence Livermore National Lab., CA (United States). 1 Jan 1992. Contract N000-14-87-K-0132. From Workshop on the physics of compressible turbulent mixing; Princeton, NJ (United States); 24-27 Oct 1988. In *Advances in compressible turbulent mixing.* 634p. Order Number DE92014326. Source: OSTI; NTIS; INIS.

The behavior of supersonic free shear layers has been analyzed through numerical solution of the 2-D compressible Navier-Stokes equations. A modified McCormack scheme that is fourth order accurate in space and second order accurate in time was used. It was found that small amplitude normal velocity disturbances introduced into the flow field grew as they were convected downstream and eventually led to organized vortical structures. The growth rate of these disturbances was found to depend on the convective Mach number. It was also found that streamwise and spanwise velocity disturbances introduced into the shear layer did not grow as rapidly as the normal velocity disturbances did.

24216 (CONF-8810234–, pp. 323-332) **Numerical simulation of enhanced mixing and turbulence in supersonic flows.** Zang, T.A. (NASA Langley Research Center, Hampton, VA (US)); Drummond, J.P.; Kumar, A. Lawrence Livermore National Lab., CA (United States). 1 Jan 1992. From Workshop on the physics of compressible turbulent mixing; Princeton, NJ (United States); 24-27 Oct 1988. In *Advances in compressible turbulent mixing.* 634p. Order Number DE92014326. Source: OSTI; NTIS; INIS.

The fundamental issues involved in compressible turbulence are of great technological importance and present severe challenges for analytical, numerical, and empirical predictive methodologies. One pressing application is to hypersonic flight, especially for the internal flow in combustors. A principal objective is to optimize the efficiency of the fuel-air mixing occurring in the engine. In the very high speed vehicle configurations currently being considered, achieving a high combustor efficiency is particularly difficult. This is a consequence of the fact that with increasing vehicle Mach number, the average Mach number in the combustor also increases. As the combustor Mach number increases the degree of fuel-air mixing that can be achieved through natural convective and diffusive processes is reduced, leading to an overall decrease in combustion efficiency and thrust. Numerical methods for supersonic (and reacting) flow have matured to the point at which they are playing a key role in exploring mechanisms for enhancing mixing and turbulence in compressible flow. In this paper some representative illustrations of recent work directed towards mixing enhancement in supersonic combustors will be presented.

24217 (CONF-8810234–, pp. 335-340) **Measurements of turbulent, anisotropic density fluctuations in a rocket exhaust plume by a cross beam three-axis correlation technique.** Ball, G.J. Lawrence Livermore National Lab., CA (United States). 1 Jan 1992. From Workshop on the physics of compressible turbulent mixing; Princeton, NJ (United States); 24-27 Oct 1988. In *Advances in compressible turbulent mixing.* 634p. Order Number DE92014326. Source: OSTI; NTIS; INIS.

Theoretical predictions of chemically reacting flows are sensitive to the assumptions made concerning the level of fluctuations of scalar variables such as density and temperature. There is need for experimental data to test modelling assumptions. The measurement of fluctuating density and temperature in the high temperature exhaust plume of a rocket motor poses several daunting technical problems. The use of optical non-intrusive techniques is one means of obtaining such data and this paper describes the use of the Crossed Beam Correlation method (CBC) to obtain localized measurements of the mean square density fluctuations within a rocket exhaust plume. The method uses robust, low cost optical components and is relatively insensitive to vibration and chemical contamination and requires no flow seeding.

24218 (CONF-8810234–, pp. 341-348) **Experimental observations of shock stability and shock-induced turbulence.** Benjamin, R.F. (Los Alamos National Lab., NM (US)). Lawrence Livermore National Lab., CA (United States). 1 Jan 1992. From Workshop on the physics of compressible turbulent mixing; Princeton, NJ (United States); 24-27 Oct 1988. In *Advances in compressible turbulent mixing.* 634p. Order Number DE92014326. Source: OSTI; NTIS; INIS.

We observe the Richtmyer-Meshkov (RM) instability of a perturbed, shock-accelerated interface between different gases. Instability growth of a singly shocked interface is observed to be consistent with previous experimental data. Late-time growth visually appears nonlinear but the growth rate remains the same as during linear growth. Re-shocking the interface produces additional RM growth and substantial profile broadening, which does not show the effect of local vorticity generation.

24219 (CONF-8810234–, pp. 349-376) **Analysis of shock-interface and shock-turbulence interactions by direct simulation and turbulence transport modeling.** Besnard, D. (Centre d'Etudes de Limeil-Valenton, Villeneuve (FR)); Haas, J.F.; Rauenzahn, R. Lawrence Livermore National Lab., CA (United States). 1 Jan 1992. From Workshop on the physics of compressible turbulent mixing; Princeton, NJ (United States); 24-27 Oct 1988. In *Advances in compressible turbulent mixing.* 634p. Order Number DE92014326. Source: OSTI; NTIS; INIS.

We present three methods of analyzing shock-interface and shock- turbulence interaction: direct simulation, turbulence transport with a full Reynolds tensor, variable density transport model, and a newly developed "k-ε- ρ'^2", Model. Using direct simulations

performed with the 2D FCT code EAD, we discuss here the structure of the flow produced by a shock-interface interaction as well as shock-mixed region interaction, as obtained in shock-tube experiments. Boundary layer effects, a prominent feature of such experiments, are examined using the 2D ALE CAVEAT code, in which the simplified model mentioned above was implemented.

24220 (CONF-8810234–, pp. 377-386) **Numerical simulation of compressible homogeneous turbulence.** Blaisdell, G.A.; Mansour, N.N.; Reynolds, W.C. Lawrence Livermore National Lab., CA (United States). 1 Jan 1992. From Workshop on the physics of compressible turbulent mixing; Princeton, NJ (United States); 24-27 Oct 1988. In *Advances in compressible turbulent mixing.* 634p. Order Number DE92014326. Source: OSTI; NTIS; INIS.

Direct numerical simulations of compressible decaying isotropic turbulence have been performed on a 643 grid. The simulations include a passive scalar with and without a mean scalar gradient. The balances for the equations of second order statistics are used to evaluate the effect of compressiblility on the turbulence. We find that the development of the fluctuations of density and of the dilatational portion of the velocity field are dependent on the initial conditions, and that the compressible terms in the balances vanish rapidly at the Reynolds numbers considered.

24221 (CONF-8810234–, pp. 387-396) **Turbulent jump relations in the interaction of a shock wave with a turbulent region.** Bonnet, M. (CEA/Centre d'Etudes de Limeil-Valenton, Villeneuve (FR)); Gauthier, S.; Spitz, P.; Sitt, B. Lawrence Livermore National Lab., CA (United States). 1 Jan 1992. From Workshop on the physics of compressible turbulent mixing; Princeton, NJ (United States); 24-27 Oct 1988. In *Advances in compressible turbulent mixing.* 634p. Order Number DE92014326. Source: OSTI; NTIS; INIS.

When a shock wave crosses a turbulent region, it can be assumed that there exists an equivalent average shock front, through which average flow variables, turbulent transport fluxes and source terms undergo jumps that satisfy modified turbulent Hugoniot conditions, independently of the closure model. These relations are presented and additional kinematic jump relations are also derived, so that the Richtmyer-Meshkov turbulent source effect can be described quantitatively. With the help of the K-ϵ turbulent mixing model presented in the companion paper, the results of numerical tests of these relations performed on a classical Air-Helium shock tube computer experiment are presented and discussed.

24222 (CONF-8810234–, pp. 397-406) **Numerical simulations with a k-ϵ mixing model in the presence of shock waves.** Bonnet, M. (Centre d'Etudes de Limeil-Valenton, Villeneuve (FR)); Gauthier, S.; Spitz, P. Lawrence Livermore National Lab., CA (United States). 1 Jan 1992. From Workshop on the physics of compressible turbulent mixing; Princeton, NJ (United States); 24-27 Oct 1988. In *Advances in compressible turbulent mixing.* 634p. Order Number DE92014326. Source: OSTI; NTIS; INIS.

Rayleigh-Taylor and Richtmeyer-Meshkov instabilities occuring in the context of inertial confinement fusion have been the object of a growing interest in the recent years. While the linear growth of small perturbations on the interface between layers of different densities is relatively well understood, the non-linear stage and the subsequent turbulent phase are poorly understood. Some insights in the non-linear growth can be done by numerical simulations as opposed to the fully developed turbulent phase where models are needed. In the context of interest, the challenge was to build a ID mixing model which had to be imbedded in a ID production hydrocode. As in the Andronov pioneering work, we used closure models which are probably the only way to work out, despite the weaknesses of such an approach. Later on, these authors also published a more sophisticated model with evolution equations for every second order quantities. In the same time, turbulent mixing models became fashionable on the West and simple models and then more elaborated models were built up. Nevertheless, it is not clear yet what informations are brought by n-equation models. However, when using closure models in unsteady situations, we are faced up to some major difficulties. The first one is the need of giving an initial turbulent state. This necessity comes from the basic assumptions where variables are splitted into a mean part and a fluctuating one. In other words, statistical models are unable to describe transition mechanisms. As a result, the final state is slightly sensitive to the initialization procedure. A second difficulty arises when simulating the interaction of turbulence with a shock wave. The numerical treatment of strong discontinuities requires a numerical dissipation in order to smear out shock waves and smooth gradients, which makes them artificially less efficient in producing turbulent kinetic energy. It follows some dependence on the spatial resolution.

24223 (CONF-8810234–, pp. 407-416) **A second-order closure for supersonic turbulent flows application to the supersonic mixing.** Dussauge, J.P. (Institut de Mecanique Statistique de la Turbulence, Marseille (FR)); Quine, C. Lawrence Livermore National Lab., CA (United States). 1 Jan 1992. From Workshop on the physics of compressible turbulent mixing; Princeton, NJ (United States); 24-27 Oct 1988. In *Advances in compressible turbulent mixing.* 634p. Order Number DE92014326. Source: OSTI; NTIS; INIS.

The classical second-order closures are generally well adapted to the computation of supersonic flows in which non-linear effects due to compressibility are weak for moderate supersonic Mach numbers (Dussauge, Gaviglio, 1987). For higher Mach numbers, the structure of turbulence in boundary-layers seems altered (Laderman, Demetriades, 1979). The measurements involved are difficult, but some conclusions of this analysis are in agreement with the recent work of Smits et al. 1988. A good example of the effects of compressibility is given by supersonic free shear flows, which cannot be computed with low-speed turbulence models. This is probably due to the large density fluctuations produced by the high speeds. For example, a classical k-ϵ model does not reproduce the spreading rate of the supersonic free shear layer. An analysis is proposed in the present paper to take in account small departures from incompressibility caused by density fluctuations. An algebraic stress model is deduced and is used to compute free shear layers. The results are compared to measurements of mean and fluctuating quantities.

24224 (CONF-8810234–, pp. 417-425) **Evidence of Rayleigh-Taylor instabilities in tri-layer targets.** Galmiche, D. (Centre d'Etudes de Limeil-Valenton, Villenueve (FR)); Holstein, P.A.; Meyer, B.; Rostaing, M.; Wilke, N. Lawrence Livermore National Lab., CA (United States). 1 Jan 1992. From Workshop on the physics of compressible turbulent mixing; Princeton, NJ (United States); 24-27 Oct 1988. In *Advances in compressible turbulent mixing.* 634p. Order Number DE92014326. Source: OSTI; NTIS; INIS.

In laser fusion, the Rayleigh-Taylor (RT) instability represents a major obstacle by destroying the spherical symmetry of the imploding shell, thus leading to a degradation of target performance. During implosion process, this instability may occur at the ablation layer on the outer surface, at an internal interface, or at the fuel-pusher interface during the deceleration phase. If the instability grows enough, it will buckle or break the shell and will cause fuel mix. Experiments have been carried out at Limeil on P102 laser system in order to investigate the problem of target stability under ablative acceleration and to get direct evidence of RT instability. Main experimental results are reported here. Numerical simulation have been performed with the 1-D hydrocode FCI1 coupled with a simple mixing model. We present, in the following text, part of our numerical investigations which support the occurrence of a mixed layer.

24225 (CONF-8810234–, pp. 427-436) **Shock-wave/shear layer interaction in circular supersonic jets.** Gutmark, E. (Naval Weapons Center, China Lake, CA (US)); Koshigoe, S.; Schadow, K.C. Lawrence Livermore National Lab., CA (United States). 1 Jan 1992. From Workshop on the physics of compressible turbulent mixing; Princeton, NJ (United States); 24-27 Oct 1988. In *Advances in compressible turbulent mixing.* 634p. Order Number DE92014326. Source: OSTI; NTIS; INIS.

The interaction between shock-waves and large coherent structures in a turbulent compressible jet flow, is studied experimentally. The results are compared qualitatively with trends predicted by the linear stability theory. The techniques developed for analyzing the stability of circular jets are extended to include the shock-cell interaction with the instability waves. The controlling effect on the shear

layer evolution, of the turbulent initial conditions, the shape of initial mean velocity profile, and Reynolds and Mach numbers are investigated. The shock wave strength is varied as well as the shear layer parameters, i.e., mean and turbulent velocity distribution, thickness, etc. These parameters determine the extent of penetration of the shock into the shear layer, the compression/expansion pattern, the diffusion rate of the shocks, and the shear layer instability characteristics. A possible feedback which is generated by the sound emitted from the shock/vortices interaction locations and subsequently excites the roll-up of vortices in the shear-layer, is discussed.

24226 (CONF-8810234–, pp. 437-446) **Creation and enhancement of turbulent mixing zones due to high mach number shock-interface interaction.** Houas, L. (Universite de Provence, Marseille (FR)); Ramdani, A.; Fortes, J. Lawrence Livermore National Lab., CA (United States). 1 Jan 1992. From Workshop on the physics of compressible turbulent mixing; Princeton, NJ (United States); 24-27 Oct 1988. In *Advances in compressible turbulent mixing.* 634p. Order Number DE92014326. Source: OSTI; NTIS; INIS.

The birth and growth of turbulent mixing of two gases having different densities after acceleration and deceleration by high Mach number shock waves are investigated in a double diaphragm shock tube. The gases are initially separated by an interface materialized by a thin plastic membrane. When a high Mach number shock wave accelerates the interface, this one is subjected to the Richtmyer-Meshkov instability. Different measurement techniques have been used and adapted to observe the created turbulent mixing zone : heat transfer gauges for the study of the incident mixing zone front, infrared absorption of a CO_2 vibrational-rotational laser line which provides temperature and density profiles in the mixing zone and infrared emission of CO_2 which gives the evolution of the mixing zone thickness. A fundamental problem appears in nuclear fusion: the creation and development of a turbulent mixing zone between the shell material and the thermonuclear combustible.

24227 (CONF-8810234–, pp. 447-456) **Preliminary data on the dynamics of turbulent shocklets.** Johnson, J.A. III (City College, New York, NY (US)); Johnson, L.E.; Zhang, J.; Zhang, Y. Lawrence Livermore National Lab., CA (United States). 1 Jan 1992. From Workshop on the physics of compressible turbulent mixing; Princeton, NJ (United States); 24-27 Oct 1988. In *Advances in compressible turbulent mixing.* 634p. Order Number DE92014326. Source: OSTI; NTIS; INIS.

Substantial interest exists in the coherent structures produced by supersonic free shear layers. Coherent structures play an important role when nonequilibrium and nonlinear behavior is dominated by mass and momentum transfer effects. Some have argued that the mass and momentum transfer is produced by merging coherent structures. Hence, if one knows how to manipulate the structures, the entrainment can be controlled. Our work focuses on the formation and evolution of coherent structures in the supersonic free shear layer using non-obtrusive optical diagnostics. We are specifically interested here in the turbulent shocklets which are thought to be associated with these structures. We present our first preliminary data on the shocklet profile, velocity, and production frequency; we also suggest some properties of the turbulence associated with these entities. The tube wind tunnel used is an elaboration of the configuration originally proposed by Ludwieg. A conventional shock tube is modified by inserting a layer-spilling asymmetric supersonic nozzle into the section upstream from the diaphragm (the high pressure section). When the diaphragm breaks, an expansion wave moves upstream into the high pressure section through the nozzle causing the local pressure, density and gas velocity to change with time and as a function of distance from the diaphragm's location. At a time determined by the ratio of the nozzle's throat area to its exit area, the nozzle is choked, i.e., the mass flow rate is frozen, and stable supersonic flow is established in the exit region. The steady period's duration is determined by the round-trip time for the head of the expansion wave to travel from the nozzle's throat to the high pressure section's upstream end. In the literature, one can find derivations of the formulas relating the nozzles parameters to the initial conditions of the tube.

24228 (CONF-8810234–, pp. 457-472) **The interaction of a supernova remnant with interstellar clouds using high order local adaptive mesh refinement methods.** Klein, R.I. (Lawrence Livermore National Lab., CA (US)); Colella, P.; McKee, C.F. Lawrence Livermore National Lab., CA (United States). 1 Jan 1992. From Workshop on the physics of compressible turbulent mixing; Princeton, NJ (United States); 24-27 Oct 1988. In *Advances in compressible turbulent mixing.* 634p. Order Number DE92014326. Source: OSTI; NTIS; INIS.

The interaction between supernova remnants (SNR) and interstellar clouds in the galaxy is known to play a major role in determining the structure of the interstellar medium (ISM). We know that the ISM is highly inhomogeneous, consisting of both diffuse atomic clouds ($T\sim100K$) and dense molecular clouds ($T\sim10K$) surrounded by a low density warm ionized gas ($T\sim10^4K$) and by a very hot coronal gas ($T\sim10^6K$). Next to radiation directly from stars, supernova explosions represent the most important form of energy injection into the ISM; they determine the velocity of interstellar clouds, accelerate cosmic rays, and can compress clouds to gravitational instability, possibly spawning a new generation of star formation. The shock waves from supernova remnants can compress, accelerate, disrupt and render hydrodynamically unstable interstellar clouds, thereby ejecting mass back into the intercloud medium. Thus, while the interaction of the SNR blast wave with cloud inhomogeneities can clearly alter the appearance of the ISM, the cloud inhomogeneities can similarly have a profound effect on the structure of the SNR.

24229 (CONF-8810234–, pp. 473-503) **Instability of shock-accelerated interface between two media.** Meshkov, E.E. Lawrence Livermore National Lab., CA (United States). 1 Jan 1992. From Workshop on the physics of compressible turbulent mixing; Princeton, NJ (United States); 24-27 Oct 1988. In *Advances in compressible turbulent mixing.* 634p. Order Number DE92014326. Source: OSTI; NTIS; INIS.

Experimental results on shock tube studies of the instability of a shock-accelerated interface between two gases are presented in this review. Turbulent mixing appears after instability development when the interface is accelerated by a series of plane stationary waves. Nonlinear effects are described, which accompany the development of distortions, that are reflected and refracted at the shock wave/expansion wave interface. A local cumulation phenomenon caused by shock reflection at the perturbed interface is described.

24230 (CONF-8810234–, pp. 505-513) **Numerical simulation of turbulent mixing in shock-tube experiments.** Mikaelian, K.O. (Lawrence Livermore National Lab., CA (US)). Lawrence Livermore National Lab., CA (United States). 1 Jan 1992. From Workshop on the physics of compressible turbulent mixing; Princeton, NJ (United States); 24-27 Oct 1988. In *Advances in compressible turbulent mixing.* 634p. Order Number DE92014326. Source: OSTI; NTIS; INIS.

We have carried out a number of 2D numerical simulations on an ALE code for shock-tube experiments in which a shock crosses one or more contact discontinuities and, after traveling through a homogeneous medium, reflects off a rigid wall at the end of the shock-tube and re-crosses the contact discontinuity. As indicated in Fig.1 , we have considered two-fluid and three-fluid experiments: the first fluid, which carries the original shock, is air; the other fluids are helium, freon, SF_6, or air again. Helium is lighter than air, while 6 freon and SF_6 are heavier than air. The interface(s) between the fluids serve as contact discontinuities and are subjected to the original shock, the re-shock, and subsequent rarefaction/compressions. When the incoming shock has M_s=l .2, it takes a little over 1 ms and 2 ms for the re-shock in the 60 cm helium and the 30 cm freon cases, respectively. Subsequent reverberations of the shock are weaker and act to slow down the interface at later times. We have carried out numerical simulations for five types of experiments as indicated in Fig. 1. Single-scale/single-interface experiments are of the classical type considered theoretically by 2 Richtmyer and experimentally by Meshkov. Perturbations of amplitude q and wavelength λ evolve according to dn/dt = n(O)(2-π/λ)Aδv where A is the Atwood number and Δv is the jump velocity

of the interface. Perturbations grow for both positive A and negative A as considered by Richtmyer and Meshkov, respectively. Figure 2 shows the air/helium case. As expected, when A<O the amplitude goes through zero (second frame in Fig. 2) and grows with the opposite phase. The reflected shock, indicated by the arrow, sees a positive A and increases the growth rate without changing phase. To cover multiple shocks, we extended Richtmyer's formula by adding n(0) to it, so that after each shock the amplitude evolves according to (Ref. 3).

24231 (CONF-8810234–, pp. 515-524) **Computations of supersonic flows: Shears, shocks, and detonations.** Oran, E.S. (Naval Research Lab., Washington, DC (US)); Boris, J.P.; Kailasanath, K. Lawrence Livermore National Lab., CA (United States). 1 Jan 1992. From Workshop on the physics of compressible turbulent mixing; Princeton, NJ (United States); 24-27 Oct 1988. In *Advances in compressible turbulent mixing.* 634p. Order Number DE92014326. Source: OSTI; NTIS; INIS.

This paper describes some of the basic features of and physical mechanisms controlling two types of supersonic flows: detonations and supersonic shear layers. Gas-phase detonations are supersonic flows in which a leading shock is driven through an energetic material by local energy release. The material behind the leading shock front of a detonation is highly disturbed and contains many interacting shocks, shears layers, and reaction zones that produce cell-like patterns on the chamber containing the flow. Supersonic shear layers often are extremely irregular and noisy and show strong interactions between shocks and vortical structures. This paper first discusses the roll of shocks in suppressing mixing and vortex merging in shear flows, and then discusses the effects of shock interactions on pattern formation and vorticity generation behind propagating detonations.

24232 (CONF-8810234–, pp. 525-533) **Essentially non-oscillatory shock capturing methods applied to turbulence amplification in shock wave calculations.** Osher, S. (Univ. of California, Los Angeles (US)); Shu, Chiwang. Lawrence Livermore National Lab., CA (United States). 1 Jan 1992. Grant NAG-1-270;Grant N000-14-86-K-0691;Grant DMS88-10150. From Workshop on the physics of compressible turbulent mixing; Princeton, NJ (United States); 24-27 Oct 1988. In *Advances in compressible turbulent mixing.* 634p. Order Number DE92014326. Source: OSTI; NTIS; INIS.

ENO (essentially non-oscillatory) schemes can provide uniformly high order accuracy right up to discontinuities while keeping sharp, essentially non-oscillatory shock transitions. Recently we obtained an efficient implementation of ENO schemes based on fluxes and TVD Runge-Kutta time discretizations. The resulting code is very simple to program for multi-dimensions. ENO schemes are especially suitable for computing problems with Both discontinuities And fine structures in smooth regions, such as shock interaction with turbulence, for which results for one dimensional and two dimensional Euler equations are presented. We observe much better resolution by using third order ENO schemes than by using second order TVD schemes for such problems.

24233 (CONF-8810234–, pp. 535-542) **Shock-generated turbulence.** Picone, J.M. (Naval Research Lab., Washington, DC (US)); Boris, J.P. Lawrence Livermore National Lab., CA (United States). 1 Jan 1992. From Workshop on the physics of compressible turbulent mixing; Princeton, NJ (United States); 24-27 Oct 1988. In *Advances in compressible turbulent mixing.* 634p. Order Number DE92014326. Source: OSTI; NTIS; INIS.

We review our theoretical and numerical results on the initiation of turbulence by shocks. Problems which have been addressed include turbulent cooling of laser and electric discharge channels in a gas, shock-flame interactions, and shock propagation through inhomogeneous fluids. The central issue is the identification of a nonlinear mechanism underlying the production of turbulence in an inviscid medium by flows that are initially irrotational with local density and pressure gradients aligned. The basis for our theory is the observation that vorticity is generated when the local pressure and density distributions are misaligned. The theory is nonlinear and supersedes linear treatments of shock-flame and shock-bubble interactions. In the case of hot, gaseous channels, no appropriate theory had existed beforehand. As an example, we present numerical simulations and analytic models which have given useful descriptions of evolving, hot, gaseous channels. This work has led to a successful method of suppressing turbulence in channels produced by lasers.

24234 (CONF-8810234–, pp. 543-552) **Numerical simulations of turbulent supersonic flows.** Pouquet, A. (National Center for Atmospheric Research, Boulder, CO (US)); Passot, T. Lawrence Livermore National Lab., CA (United States). 1 Jan 1992. From Workshop on the physics of compressible turbulent mixing; Princeton, NJ (United States); 24-27 Oct 1988. In *Advances in compressible turbulent mixing.* 634p. Order Number DE92014326. Source: OSTI; NTIS; INIS.

Compressible flow calculations are reported using periodic boundary conditions, with r.m.s. Mach number of order unity. In the turbulent regime, the temporal evolution of the Mach number is mild, the flow retaining some of its compressible character for long times, with strong small-scale vortices visible in the two-dimensional case, forming in the vicinity of shocks. In the non-acoustic regime, large scales are dominated by shear motions, and small scales by shocks, with substantial inequipartition. The inertial range spectral index in dimension two for the compressible component of the velocity is close to -2, reminiscent of observations in several molecular clouds which are the site of star formation. One clear feature of three- dimensionality is the marked appearance of regions of low density.

24235 (CONF-8810234–, pp. 553-562) **Shock enhancement of a turbulent flow.** Rotman, D. (Lawrence Livermore National Lab., CA (US)). Lawrence Livermore National Lab., CA (United States). 1 Jan 1992. From Workshop on the physics of compressible turbulent mixing; Princeton, NJ (United States); 24-27 Oct 1988. In *Advances in compressible turbulent mixing.* 634p. Order Number DE92014326. Source: OSTI; NTIS; INIS.

Presented here are calculations describing the enhancement of turbulence caused by the passing of a shock wave. This field is of interest to those investigating the Richtmyer-Meshkov instability, supersonic combustion, fusion and many others. Experiments involving shocks and turbulence (Sturtevant, et. al. 1980, Smits and Muck 1987, Trolier and Duffy 1984) show that the turbulence level following a shock wave can be as much as 3 times higher then that before the shock. Predictions from linear theory (McKenzie and Westphal 1968 and Anyiwo and Bushnell 1982) show very similar shock enhancements. Recent calculations involving nonlinear effects (Kumar et. al. 1987 and Viecelli 1988) show promise in explaining how this enhancement is obtained. This study will use a shock tube type calculation domain to investigate the effect of a shock wave on pre-existing turbulence.

24236 (CONF-8810234–, pp. 563-570) **Nova mix experiments.** Rupert, V.C. (Lawrence Livermore National Lab., CA (US)); Kilkenny, J.D.; Skokowski, P.G. Lawrence Livermore National Lab., CA (United States). 1 Jan 1992. From Workshop on the physics of compressible turbulent mixing; Princeton, NJ (United States); 24-27 Oct 1988. In *Advances in compressible turbulent mixing.* 634p. Order Number DE92014326. Source: OSTI; NTIS; INIS.

The NOVA mix experiments are designed to study mix between two dissimilar materials subjected to strong (M ≈50) shocks and variable accelerations in a direction normal to their common boundary. The main purpose of the experiments is to provide a data base with which predictive models can be compared and normalized. Together with shock tube experiments, which explore a different regime, the current NOVA tests investigate the shock induced source terms in our model and the evolution of both Rayleigh-Taylor stable and unstable interfaces.

24237 (CONF-8810234–, pp. 571-580) **Rayleigh Taylor instability observations of shock accelerated gases.** Stearman, N.C. (Atomic Weapons Establishment, Essex (GB)). Lawrence Livermore National Lab., CA (United States). 1 Jan 1992. From Workshop on the physics of compressible turbulent mixing; Princeton, NJ (United States); 24-27 Oct 1988. In *Advances in compressible turbulent mixing.* 634p. Order Number DE92014326. Source: OSTI; NTIS; INIS.

The initial aim of this work was to reproduce the work of Meshkov et al by using a shock tube of 8x2 inch cross section to produce high acceleration gradients in gases initially at atmospheric pressure and thus observe the growth of Raleigh Taylor instabilities. The work has since diversified and has to date included two interface geometries and also isolated bubble studies. In both cases the interaction of refrigerant 12 (freon), density 5.36 gm/litre, with both air, 1.2 gm/l, and helium, 0.18 gm/l, has been observed using shadowgraphy and compared with 1-D and 2-D computer simulations. Gas separation in the first case was achieved by the use of a thin membrane produced by pouring a solution of basically nitrocellulose on to a water surface and allowing the solvents to evaporate. The thickness of the resulting membrane may be ascertained from the colours reflected, (as with oil on water). Most of the membranes used reflected no colour at all indicating that the thickness is less than half a wavelength of visible light, i.e. approximately 0.2 microns. Photographs obtained from three tests of each of air/freon/air and air/freon/helium are shown. Flat topped air shocks of approximately 0./6 bar overpressure, were incident on the layer. Two dimensional numerical simulations of the situations are shown in figs 5a, b and a correspondence is clearly visible in many distinctive features.

24238 (CONF-8810234–, pp. 581-606) **Experimental research of gravitational instability and turbulization of flow at the noble gases interface.** Vasilenko, A.M.; Buryakov, O.V.; Kuropatenko, V.F.; Olkhovskaya, V.I.; Ratnikov, V.P.; Jakovlev, V.G. Lawrence Livermore National Lab., CA (United States). 1 Jan 1992. From Workshop on the physics of compressible turbulent mixing; Princeton, NJ (United States); 24-27 Oct 1988. In *Advances in compressible turbulent mixing.* 634p. Order Number DE92014326. Source: OSTI; NTIS; INIS.

A special type of turbulence - gravitational turbulence appears at the interface of media having different densities under nonstationary motion because of Taylor instability. This phenomenon takes place, for example, when nonstationary shockwaves pass through nonhomogeneous media. Theoretical description of the development of small interface perturbations is of no difficulty but in the process of experimental work it came out, that the growth of finite perturbations, comparable with the wave length, leads to the distortion of their initial form and complicates the analytical examination of this problem. Gravitational turbulent mixing theoretical research made by Belyenkii and Fradkin and some other authors is of semi-empirical character. In some works gravitational instability numerical research on the ground of Euler nonstationary equations with two spatial variables was carried out. Experimentally this problem is also poorly investigated. There are few works devoted to this question. The aim of this work is the experimental research of turbulization process of interface perturbations for gases having different densities under the influence of the strong decelerating shockwave under the condition of essential compressibility of initial substance. The noble gases choice was made in terms of the equality of their adiabatic compressibility. This sufficiently simplifies the experimental analysis.

24239 (CONF-8810234–, pp. 607-626) **Experimental investigation of turbulent mixing by Rayleigh-Taylor instability.** Youngs, D.L. (Atomic Weapons Establishment, Reading (GB)). Lawrence Livermore National Lab., CA (United States). 1 Jan 1992. From Workshop on the physics of compressible turbulent mixing; Princeton, NJ (United States); 24-27 Oct 1988. In *Advances in compressible turbulent mixing.* 634p. Order Number DE92014326. Source: OSTI; NTIS; INIS.

A key feature of compressible turbulent mixing is the generation of vorticity via the $\nabla p \times \nabla(1/\rho)$ term. This source of vorticity is also present in incompressible flows involving the mixing of fluids of different density, for example Rayleigh-Taylor unstable flows. This paper gives a summary of an experimental investigation of turbulent mixing at a plane boundary between two fluids, of densities ρ_1, and ρ_2. ($\rho_1 > \rho_2$) due to Rayleigh-Taylor instability. The two fluids are near incompressible and mixing occurs when an approximately constant acceleration, g, is applied normal to the interface with direction from fluid 2 to fluid 1. Full details of the experimental programme are given in a set of three reports. Some of the earlier experiments are also described by Read. Previous experimental work and much of the theoretical research has concentrated on studying the growth of the instability from a single wavelength perturbation rather than turbulent mixing. Notable exceptions are published in the Russian literature. A related process, turbulent mixing induced by the passage of shock waves though an interface between fluids of different density is described by Andronov et al. The major purpose of the experiments described here was to study the evolution of the instability from small random perturbations where it is found that large and larger structures appear as time proceeds. A novel technique was used to provide the desired acceleration. The two fluids were enclosed in a rectangular tank, the lighter fluid 2 initially resting on top of the denser fluid 1. One or more rocket motors were then used to drive the tank vertically downwards. The aim of the experimental programme is to provide data for the calibration of a turbulence model used to predict mixing in real situations.

24240 (DOE/ER/12813–T1) **Neural network approaches to tracer identification as related to PIV research.** Seeley, C.H. Jr. Texas A and M Univ., College Station, TX (United States). Dec 1992. 101p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-88ER12813. Order Number DE93011399. Source: OSTI; NTIS; INIS; GPO Dep.

Neural networks have become very powerful tools in many fields of interest. This thesis examines the application of neural networks to another rapidly growing field flow visualization. Flow visualization research is used to experimentally determine how fluids behave and to verify computational results obtained analytically. A form of flow visualization, particle image velocimetry (PIV). determines the flow movement by tracking neutrally buoyant particles suspended in the fluid. PIV research has begun to improve rapidly with the advent of digital imagers, which can quickly digitize an image into arrays of grey levels. These grey level arrays are analyzed to determine the location of the tracer particles. Once the particles positions have been determined across multiple image frames, it is possible to track their movements, and hence, the flow of the fluid. This thesis explores the potential of several different neural networks to identify the positions of the tracer particles. Among these networks are Backpropagation, Kohonen (counter-propagation), and Cellular. Each of these algorithms were employed in their basic form, and training and testing were performed on a synthetic grey level array. Modifications were then made to them in attempts to improve the results.

24241 (DOE/ER/12813–T2) **Development and application of a high speed digital data acquisition technique to study steam bubble collapse using particle image velocimetry.** Schmidl, W.D. Texas A and M Univ., College Station, TX (United States). Aug 1992. 75p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-88ER12813. Order Number DE93011769. Source: OSTI; NTIS; INIS; GPO Dep.

The use of a Particle Image Velocimetry (PIV) method, which uses digital cameras for data acquisition, for studying high speed fluid flows is usually limited by the digital camera's frame acquisition rate. The velocity of the fluid under study has to be limited to insure that the tracer seeds suspended in the fluid remain in the camera's focal plane for at least two consecutive images. However, the use of digital cameras for data acquisition is desirable to simplify and expedite the data analysis process. A technique was developed which will measure fluid velocities with PIV techniques using two successive digital images and two different framing rates simultaneously. The first part of the method will measure changes which occur to the flow field at the relatively slow framing rate of 53.8 ms. The second part will measure changes to the same flow field at the relatively fast framing rate of 100 to 320 μs. The effectiveness of this technique was tested by studying the collapse of steam bubbles in a subcooled tank of water, a relatively high speed phenomena. The tracer particles were recorded and velocity vectors for the fluid were obtained far from the steam bubble collapse.

24242 (DOE/ER/13641–7) **Thinning and rupture of a thin liquid film on a heated surface: Progress report, September 15, 1992–September 14, 1993.** Bankoff, S.G.; Davis, S.H. Northwestern Univ., Evanston, IL (United States). 1993. 6p. Sponsored

by USDOE, Washington, DC (United States). DOE Contract FG02-86ER13641. Order Number DE93015563. Source: OSTI; NTIS; GPO Dep.

The objective of this work continues to be the study of the dynamics, stability and rupture of thin liquid films, especially with heat and/or mass transfer. These films appear in many engineering processes, such as film coating, gas absorption, condensation, and especially cooling of hot surfaces. Surface waves may be detrimental, leading to film breakdown, with consequent equipment overheating, or beneficial, as when mass transfer coefficients are increased.

24243 (DOE/ER/13991–1) **Lattice gas hydrodynamics: Theory and simulations: Final report.** Hasslacher, B. California Univ., La Jolla, CA (United States). [1993]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG03-89ER13991. Order Number DE93013537. Source: OSTI; NTIS; GPO Dep.

The first successful application of a microscopic analogy to create a skeleton cellular automaton and analyze it with statistical mechanical tools, was the work of Frisch, Hasslacher and Pomeau on the Navier-Stokes equation in two and three dimensions. This has become a very large research area with lattice gas models and methods being used for both fundamental investigations into the foundations of statistical mechanics and a large number of diverse applications. This present research was devoted to enlarging the fundamental scope of lattice gas models and proved quite successful. Since the beginning of this proposal, cellular automata have been constructed for statistical mechanical models, fluids, diffusion and shock systems in fundamental investigations. In applied areas, there are now excellent lattice gas models for complex flows through porous media, chemical reaction and combustion dynamics, multiphase flow systems, and fluid mixtures with natural boundaries. With extended cellular fluid models, one can do problems with arbitrary pairwise potentials. Recently, these have been applied to such problems as non-newtonian or polymeric liquids and a mixture of immiscible fluids passing through fractal or spongelike media in two and three dimensions. This proposal has contributed to and enlarged the scope of this work.

24244 (DOE/ER/14182–2) **Mixing of immiscible fluids in chaotic flows and related issues: Progress report, June 1, 1992–May 31, 1993.** Ottino, J.M. Northwestern Univ., Evanston, IL (United States). 30 Mar 1993. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-91ER14182. Order Number DE93012806. Source: OSTI; NTIS; INIS; GPO Dep.

The basis goal of this work was to obtain a basic understanding of mixing of immiscible fluids leading to the determination of flow conditions which result in efficient breakup and dispersion of one mass of fluid in the bulk of another. Related issues were the prediction of the morphological structures and drop size distribution for a given set of operating conditions. The primary motivation for these investigations was to produce basic knowledge leading to increased understanding of industrial processes involving blending, agitation, emulsification, and dissolution.

24245 (DOE/FTR–93011813) **[A trip to Germany to present four lectures on flow turbulence and combustion]: Foreign trip report, September 12–30, 1992.** Ashurst, W.T. Sandia National Labs., Albuquerque, NM (United States). [1992]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DR00789. Order Number DE93011813. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The primary purpose of this foreign travel was to present four lectures at the Summer School given by the European Research Community on Flow Turbulence and Combustion (ERCOFTAC) located at RWTH University in Aachen, Germany. The objective of this two week Summer School was a combined lecture/workshop introduction to turbulent combustion for researchers not familiar with the topic. Of the 39 lectures, 15 were given by Professor Norbert Peters and four were given by Dr. Ashurst. A second purpose of this trip was the presentation of a seminar at the University of Grenoble, Institute of Mechanics and technical discussions with Professor M. Lesieur regarding turbulent structure.

24246 (DOE/MC/25048–3353) **Collaborative research on fluidization employing computer-aided particle tracking: Quarterly progress report No. 5, October 1, 1989–December 31, 1989.** Chen, M.M. Illinois Univ., Urbana, IL (United States). Dept. of Mechanical and Industrial Engineering. 1989. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC21-88MC25048. Order Number DE93013360. Source: OSTI; NTIS; GPO Dep.

The primary objective of this work was debugging and testing of the hardware and software of the transportable computer-aided particle tracking apparatus to be used at the Morgantown Energy Technology Center. Earlier effort was devoted to system interconnection and software development. While the hardware interconnections have been finished, the software development and debugging was completed in this quarter with successful initial testing. Two tracer particles were also made from 1/8th inch nylon particles, and they will be sent to METC soon.

24247 (DOE/NV/10872–T53) **Heat transfer in unsaturated, porous media.** Nevada Univ., Las Vegas, NV (United States). [1993]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC08-90NV10872. Order Number DE93014239. Source: OSTI; NTIS; GPO Dep.

During this period, a Christiansen cell has been designed and constructed. A calibration cell has also been designed and constructed. At the present time, the optical components are being configured into the final form to perform experiments. an additional apparatus to study a related configuration is also being designed.

24248 (DOE/PC/90184–T10) **Nuclear magnetic resonance studies of granular flows: Technical progress report for the quarter ending March 31, 1993.** Lovelace Medical Foundation, Albuquerque, NM (United States). 1993. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-90PC90184. Order Number DE93014955. Source: OSTI; NTIS; GPO Dep.

We have initiated an effort to enlarge the sample space within the magnet by designing a larger NMR probe. The new probe will be similar to the old, i.e., it will be an 8-rung, high-pass birdcage coil but with inner diameter of 5.7511 (14.6 cm) rather than the present 4.7511 (12.1 cm). If we are successful, we will push on to a yet larger diameter. The reason these redesigns are not trivial is the presence of an rf shield around the probe at a diameter of 24 cm to decouple the high power rf pulses from the shim and gradient coils that are would outside the coil. Thus, the return rf magnetic field, i.e., that part of the field that is not inside the birdcage itself, must be confined to the annular space between the shield and the coil, ultimately lowering the quality factor Q of the coil and altering the tuning. We have also derived an expression for a one-dimensional velocity profile of mustard seeds flowing in a partially filled rotating drum.

24249 (INIS-mf–13503, pp. 24-26) **A high fidelity model and code generator for the simulation of BOP systems.** Galen, S. (S3 Technologies, Columbia, Maryland (United States)); Vinay, M. European Nuclear Society (ENS), Bern (Switzerland); Czech Nuclear Society, Prague (Czech Republic); Slovak Nuclear Society, Bratislava (Slovakia). Jan 1993. (CONF-921068–: East-West topical meeting: the safe and reliable operation of light water reactor NPP's, Prague (Czechoslovakia), 18-21 Oct 1992). In *Topform '92: the safe and reliable operation of LWR NPPs. Vol. II: Poster papers.* [245p.] Order Number DE93625345. Source: OSTI; NTIS (US Sales Only); INIS.

TOPMERET represents a significant advance in the modelling fidelity of Balance of Plant systems (BOP). It is extremely flexible and can accommodate a variety of systems, including main steam, feedwater, turbine, condenser, offgas, large volumes, such as the containment, and water systems such as service water. It handles both normal and abnormal operating scenarios, including pipe break accidents. It was tested successfully on various simulators, and meets the fidelity required of BOP system models so as to successfully integrate with the high level of control automation of European designs. (Z.S.) 1 ref.

24250 (LBL–32529) **The method of Laplace Transform MultiQuadrics (LTMQ) for the solution of the groundwater flow equation.** Moridis, G.J. (Lawrence Berkeley Lab., CA (United

States)); Kansa, E. Lawrence Berkeley Lab., CA (United States). Jun 1992. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. (CONF-9306153–1: 7. International Association for Mathematical and Computers in Simulation (IMACS) conference on computer methods for partial differential equations, New Brunswick, NJ (United States), 22-24 Jun 1993). Order Number DE93010408. Source: OSTI; NTIS; GPO Dep.

This paper presents a new numerical method, the Laplace Transform MultiQuadrics (LTMQ) method, developed for the solution of the diffusion-type parabolic Partial Differential Equation (PDE) of fluid flow through porous media. LTMQ combines a Multi-Quadrics (MQ) approximation scheme with a Laplace transform formulation. The use of MQ in the spatial approximations allows the accurate description of problems in complex porous media with a very limited number of nodes. The Laplace transform formulation eliminates the need for time discretization, thus allowing an unlimited time step size without any loss of accuracy. LTMQ is tested against results from three test problems of groundwater flow obtained from a standard Finite Difference (FD) model, as well as from analytical solutions. An excellent agreement between the LTMQ and the analytical and FD solutions is observed, while significant reductions in computer execution times may be achieved.

24251 (NAL-TM–648T) **Numerical wind tunnel project computational fluid dynamics at National Aerospace Laboratory, Japan.** Hirose, N. (National Aerospace Laboratory, Tokyo (Japan)). National Aerospace Lab., Chofu, Tokyo (Japan). Jul 1992. 11p. Order Number DE93793615. Source: OSTI; NTIS; Available from National Aerospace Laboratory, 44-1, Shindaiji Higashicho 7-chome, Chofu-City, Tokyo, Japan.

The progress report of the numerical wind tunnel project and computational fluid dynamics (CFD) at National Aerospace Laboratory (NAL), Japan, presented to the 3rd ISNaS symposium opened in Netherlands in Sep. 1991. The history of the NAL's computer system from 1960 to 1991, and the present numerical simulation facility mainly composed of FACOM supercomputers are outlined together with graphics terminals connected with host computers through LAN. The progress of the feasibility study of the numerical wind tunnel project released in 1989 is also outlined. On CFD researches at NAL, the studies of FEM grid generation methods, Euler/Navier-Stokes equation codes and turbulence models are presented. On applications to the national aerospace projects, those to the developmental projects of YXX, ASKA and SST, and the aerodynamic simulation results of the space vehicle HOPE are outlined as well as the future projects. 3 refs., 5 figs., 4 tabs.

24252 (NAL-TR–1156) **Simulated wake characteristics of tapered annular wings by a discrete vortex method.** Okuyama, M. (National Aerospace Laboratory, Tokyo (Japan)); Makino, M. National Aerospace Lab., Chofu, Tokyo (Japan). May 1992. 15p. (In Japanese). Order Number DE93793620. Source: OSTI; NTIS; Available from National Aerospace Laboratory, 44-1, Shindaiji Higashicho 7-chome, Chofu-City, Tokyo, Japan.

With an objective to discuss wake vortex roll-in as a wake characteristic of tapered annular wings, numerical simulation was performed on wakes of wings with two different shapes using a discrete vortex method, and a wake observation was made on a plate type model using a smoke wind tunnel. The test specimens are box-type wings and rectangular wings with the same aspect ratio of 2 as in the annular wings. The simulation provided the following results: A process for a vortex layer in the tapered annular wing to get rolled in to turn into a wake swirl consumes more time than in the case with generally used wings; and a tapered annular wing differs from a non-tapered wing in that a vortex layer in the vicinity of the upper center part remains in the upper part after the roll-in process. Wake observations with a simulation and smoke were compared. A pathline on the wing center seen in the smoke observation tended to be indicated longer. A pathline in the vicinity of the wind tunnel wall did not agree with the simulation result. This should have been because wall interference has occurred. However, both agreed with each other in the wake of a potential flow zone. 8 refs., 14 figs.

24253 (NAL-TR–1157) **Simulated and experimental aerodynamic characteristics of tapered annular wings.** Okuyama, M. (National Aerospace Laboratory, Tokyo (Japan)); Makino, M. National Aerospace Lab., Chofu, Tokyo (Japan). May 1992. 32p. (In Japanese). Order Number DE93793621. Source: OSTI; NTIS; Available from National Aerospace Laboratory, 44-1, Shindaiji Higashicho 7-chome, Chofu-City, Tokyo, Japan.

With an objective of identifying aerodynamic characteristics of tapered annular wings, the equations of the quasi-vortex lattice method for planer wings were extended to those that can be applied to the tapered annular wings, and the longitudinal aerodynamic characteristics were calculated using numerical calculations according to the above equations. To compare the results with measurements, a wind tunnel experiment was carried out using two kinds of models. The numerical calculations provided data for effects of the number of binding vortex and the number of one wing division in the wing width direction on the convergence of lift curve slope and induced drag, and relationship between the calculation result and Mach numbers. Six-component measurements provided the longitudinal aerodynamic characteristics. The comparison revealed the following: These calculations can infer approximately the experimental data on such longitudinal aerodynamic characteristics as the lift coefficients and pitching moment coefficients other than the induced drag. Lateral aerodynamic characteristics were obtained from a wind tunnel experiment on a model made of boards. This experiment achieved a result that the lateral inclination of the model with a taper ratio of 0.15 is smaller by 20% than that for a model with a taper ratio of one. 7 refs., 26 figs., 1 tab.

24254 (NAL-TR–1172) **New aerodynamic information obtained from the solution of the inverse problem for aerofoils.** Shigemi, M. (National Aerospace Laboratory, Tokyo (Japan)). National Aerospace Lab., Chofu, Tokyo (Japan). Jul 1992. 12p. (In Japanese). Order Number DE93793625. Source: OSTI; NTIS; Available from National Aerospace Laboratory, 44-1, Shindaiji Higashicho 7-chome, Chofu-City, Tokyo, Japan.

An inverse problem was solved from a pressure distribution around an aerofoil as derived from an experiment to seek an aerofoil shape that realizes the pressure distribution. Flows given on a boundary layer were solved using the inverse problem varying such parameters as the aerofoil elevation angles and the flow Reynolds number. In the present work, a method was used that a Laplace equation is solved that is a governing equation hypothesizing a flow without vortices (solution of a forward problem) to derive an object shape that realizes the very flow. The following findings were obtained: This method is effective for the case with a low Reynolds number, and can obtain an aerofoil with high accuracy upon less repetition of calculations; no convergence solution can be derived when the Reynolds number is high; a method to express displacement effect of the boundary layer by adding a displacement thickness of the boundary layer to the original aerofoil thickness is thought to have a practical reasonability; change in the pressure distribution occurs from local change in curvature of the aerofoil face; and with a flow flowing along a flat plate, a correction amount of the surface coordinates is equal to the displacement thickness. This can be introduced mathematically. 9 refs., 15 figs.

24255 (SAND–92-0480) **Downstream evolution of turbulence from heated screens: Experimental and analytical results.** O'Hern, T.J.; Shagam, R.N.; Neal, D.R.; Suo-Anttila, A.J.; Torczynski, J.R. Sandia National Labs., Albuquerque, NM (United States). Feb 1993. 111p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. Order Number DE93012396. Source: OSTI; NTIS; GPO Dep.

This report discusses recent efforts to characterize the flow and density nonuniformities downstream of heated screens placed in a uniform flow. The Heated Screen Test Facility (HSTF) at Sandia National Laboratories and the Lockheed Palo Alto Flow Channel (LPAFC) were used to perform experiments over wide ranges of upstream velocities and heating rates. Screens of various mesh configurations were examined, including multiple screens sequentially positioned in the flow direction. Diagnostics in these experiments included pressure manometry, hot-wire anemometry, interferometry, Hartmann wavefront slope sensing, and photorefractive schlieren photography. A model was developed to describe the downstream evolution of the flow and density nonuniformities. Equations for the spatial variation of the mean flow quantities and

the fluctuation magnitudes were derived by incorporating empirical correlations into the equations of motion. Numerical solutions of these equations are in fair agreement with previous and current experimental results.

4205 Materials Testing

Refer also to citation(s) 23674, 23754, 23941, 23976, 23986, 24023, 24076, 24431, 24487, 24493, 24495, 24519, 25004, 25336

24256 (CONF-921275–, pp. 45-48) **Basic discussion on automating magnetic powder flaw detection using image processing.** Suzuki, S. (Yokohama National University, Yokohama (Japan). Faculty of Engineering); Sekine, K. 2 Dec 1992. 160p. (In Japanese). From 25. safety engineering study meeting; Kitakyushu (Japan); 2-3 Dec 1992. In *Proceedings of the 25th Safety Engineering Study Meeting.* Order Number DE93793904. Source: OSTI; NTIS (US Sales Only).

Magnetic powder flaws are detected on sites by visually determining formed defect indicating patterns. This paper discusses a method to extract defects through an image processing to show them clearly on a screen and evaluate them quantitatively with an objective to improve the detection reliability. Used for a test was a test piece with line-like defects clad by welding on billets and grooves on which surface defects exist. A test piece slanted at 30 degrees to a plane was magnetized, on which an inspection liquid containing fluorescent magnetic powder with grain sizes from 5μm to 20μm was sprinkled using an Eulerian method. A reflected light obtained by irradiating ultraviolet rays on the test piece was taken into a CCD camera. The image data were digitized so that an image displayed on a screen is formed with 256×240 picture elements to show the picture elements with concentration values in 256 levels. As a result of giving such devices as making noises into binary values using a template to distinguish them according to surface irregularities, labelling the coupled components, and classifying the shapes, the resultant images were verified to have extracted nearly only the defects intended to be detected. 3 refs., 9 figs.

24257 (DOE/CE/40777–9) **On-machine sensors to measure paper mechanical properties.** Hall, M.; Brodeur, P.; Lorenz, K.; Jackson, T. Institute of Paper Science and Technology, Atlanta, GA (United States). [1990]. 39p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-86CE40777. (CONF-9011322–1: Advanced sensors technical conference, Atlanta, GA (United States), 12-13 Nov 1990). Order Number DE93010635. Source: OSTI; NTIS; GPO Dep.

The objective of this research is to develop sensors capable of measuring the velocity of ultrasound in the thickness and in-plane directions of paper while the paper is moving at line speed on the paper machine. It is furthermore desired to determine the response of sensors and data collection system to moving paper webs prepared with selected parameter changes.

24258 (INIS-mf–13503, pp. 56-59) **Efficient and reliable inspection through the use of optimised NDT.** Highmore, P.J. (AEA Technology, Warrington (United Kingdom)). European Nuclear Society (ENS), Bern (Switzerland); Czech Nuclear Society, Prague (Czech Republic); Slovak Nuclear Society, Bratislava (Slovakia). Jan 1993. (CONF-921068–: East-West topical meeting: the safe and reliable operation of light water reactor NPP's, Prague (Czechoslovakia), 18-21 Oct 1992). In *Topform '92: the safe and reliable operation of LWR NPPs. Vol. II: Poster papers.* [245p.] Order Number DE93625345. Source: OSTI; NTIS (US Sales Only); INIS.

Current activities within AEA Technology are described aiming at the constitution of an optimized and reliable inspection technology for the UK nuclear programme. Three main factors, i.e. optimized inspection design, efficient inspection reliability assessment and effective inspector training, influencing the efficiency and reliability of the on-site inspection are discussed. (Z.S.).

24259 (INIS-mf–13503, pp. 85-88) **Automatic eddy current inspection system.** Saariaho, P. (Imatran Voima Oy (IVO), Helsinki (Finland)). European Nuclear Society (ENS), Bern (Switzerland); Czech Nuclear Society, Prague (Czech Republic); Slovak Nuclear Society, Bratislava (Slovakia). Jan 1993. (CONF-921068–: East-West topical meeting: the safe and reliable operation of light water reactor NPP's, Prague (Czechoslovakia), 18-21 Oct 1992). In *Topform '92: the safe and reliable operation of LWR NPPs. Vol. II: Poster papers.* [245p.] Order Number DE93625345. Source: OSTI; NTIS (US Sales Only); INIS.

A description is given of a system developed by IVO for the industry standard PC to analyze eddy current signals in real time during inspection. It is based on phase angle analysis of eddy current signals which is the only possible technique to determine depths of small corrosion defects accurately. With the automated eddy current method about 500 condenser tubes can be inspected in one shift. The operation environment is an IBM PC compatible computer and graphics user interface of Microsoft Windows. (Z.S.) 4 figs.

24260 (INIS-mf–13503, pp. 89-95) **Erosion-corrosion prediction and inspection program for Krsko NPP.** Vermaut, M. (Westinghouse Energy Systems International, Brussels (Belgium)); Baltus, R.; Roarty, D.H.; Pete, D. European Nuclear Society (ENS), Bern (Switzerland); Czech Nuclear Society, Prague (Czech Republic); Slovak Nuclear Society, Bratislava (Slovakia). Jan 1993. (CONF-921068–: East-West topical meeting: the safe and reliable operation of light water reactor NPP's, Prague (Czechoslovakia), 18-21 Oct 1992). In *Topform '92: the safe and reliable operation of LWR NPPs. Vol. II: Poster papers.* [245p.] Order Number DE93625345. Source: OSTI; NTIS (US Sales Only); INIS.

Pipe wall thinning through erosion-corrosion (E/C) is a problem receiving much attention in the nuclear and non-nuclear industry, and is also involved in the Krsko nuclear power plant. In 1991, the Krsko plant decided to upgrade its inspection programme and acquired computerized systems for thickness data acquisition, management and evaluation. The Krsko plant and Westinghouse performed a systematic E/C prediction analysis for all carbon-steel high-energy piping, using the state-of-the-art computer model using the EPRI (Electric Power Research Institute) code CHECKMATE. The E/C predictions and the results of past inspections were combined to redefine a new inspection plan starting with the spring 1992 outage. The first phase of the project is described including computer modelling and the inspection plan prepared for the upcoming outage. (Z.S.) 1 tab., 4 figs., 3 refs.

24261 (SAND–92-2297C) **Experimental technique to launch flier-plates representing orbital debris to hypervelocities.** Chhabildas, L.C.; Boslough, M.B. Sandia National Labs., Albuquerque, NM (United States). [1992]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-930445–9: Society of Photo-Optical Instrumentation Engineers (SPIE) OE/aerospace science and sensing meeting, Orlando, FL (United States), 11-16 Apr 1993). Order Number DE93012838. Source: OSTI; NTIS; GPO Dep.

Very high driving pressures (tens or hundreds of GPa), are required to accelerate flier plates to hypervelocities. This loading pressure pulse on the flier plates must be nearly shockless to prevent the plate from melting or vaporizing. This is accomplished by using graded-density impactors referred to as "pillows." When this graded-density material is used to impact a flier-plate in a modified two-stage light gas gun, nearly shockless megabar pressures are introduced into the flier plate. The pressure pulses must also be tailored to prevent spallation of the flier-plate. This technique has been used to launch nominally 1-mm-thick aluminum, magnesium and titanium (gram-size) intact plates to 10.4 km/s, and 0.5-mm-thick aluminum and titanium (half-gram size) intact plates to 12.2 km/s. This is the highest mass-velocity capability attained with laboratory launchers to date, and should open up new regimes of impact physics and lethality studies related to space sciences for laboratory investigations. In particular, the mass-velocity capability of this newly developed hypervelocity launcher meets the average specifications of the space debris environment, and is therefore expected to be a useful tool to evaluate the effects of debris impact on space structures and debris shields.

24262 (UCRL-ID–111488) **Permanent magnet radiation hardness tests at the 100 MeV Linac: Preliminary results.** Kulke, B.; Palomar, J. Lawrence Livermore National Lab., CA (United States). Sep 1992. 16p. Sponsored by Department of

Defense, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE93012999. Source: OSTI; NTIS; GPO Dep.

During a five-day run at the 100 MeV Linac, we exposed 21 permanent magnet samples from four different manufacturers to 1-2 gigarad doses of 85 MeV gamma radiation, plus some direct electron radiation. Only the Sm-Co samples survived without change, while the Ne-Fe-B samples lost 1-5 percent of their initial magnetization. The loss in remanence was most extreme for three Pr-Fe-B samples (up to 75 percent loss).

24263 (UCRL-JC–106122) **Impulse gain and damage from very high dynamic loading using flyer impact.** Osher, J.; Chau, H.; Gerassimenko, M.; Lee, R.; Pomykal, G.; Terhune, R.; Weingart, R. Lawrence Livermore National Lab., CA (United States). Jul 1991. 19p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-911069–11: 3. international conference on mechanical and physical behavior of materials under dynamic loading, Strasbourg (France), 14-18 Oct 1991). Order Number DE93011957. Source: OSTI; NTIS; GPO Dep.

The Lawrence Livermore National Laboratory (LLNL) 1 MJ and 87 kJ electric guns are in use for a variety of shock-wave applications using the hypervelocity impact of dielectric (or dielectric and metal composite) flyer plates on material samples. The 1 MJ electric gun is a newly completed facility and will be described. The specific applications discussed here include a study of momentum gain and spat damage produced by Kapton flyer impact on aluminium 6061-T6. The experimental impact measurements are used to calibrate code calculations that can be applied under more general hypervelocity impact conditions to typical relative orbital velocities near 10 km/s. The analytical results of code calculations supporting these study areas are also reported.

4210 Combustion Systems

Refer also to citation(s) 22847

24264 (CONF-9207203–, pp. 22-26) **Study of CO2 recovery on P.F ombustion with oxygen/flue gas recycle.** Miyamae, S. (Ishikawajima-Harima Heavy Industries, Co. Ltd., Tokyo (Japan)); Noguchi, Y.; Maeda, U.; Tanaka, T. 22 Jul 1992. 320p. (In Japanese). From 1. meeting of The Japan Institute of Energy and the 70th Foundation anniversary meeting; Tokyo (Japan); 22-24 Jul 1992. In *Proceedings of the 1st Meeting of the Japan Institute of Energy and the 70th Foundation Anniversary Meeting.* Order Number DE93793523. Source: OSTI; NTIS (US Sales Only).

Applicability was studied of pulverized coal fueling combustion system with wet oxygen/flue gas recycling (where the oxygen is 97.5% in purity) by taking a 1000MW facilities as an object for the CO2 recovery type power generation system. In the separation and recovery of CO2 by the conventional pulverized coal/air combustion system, the CO2 is separated by the chemical absorption or physical adsorption which follows the dedusting and desulfurization, and then recovered. Inlet gas into the separation/recovery unit must be controlled in quantity of sooty dust and concentration of both SOx and NOx in order to avoid degradation and poisoning of absorbent and adsorbent. The new present system, though additionally needing an oxygen production process, is as high as 95% in CO2 concentration in the flue gas so that the recovery can be made without separation which is no longer necessary. Therefore, the flue gas treatment facilities can be considerably simplified so that reduction can be made in both installation cost and necessary power in the station. NOx is also considerably controlled. As compared with 39.1% in power sending end efficiency of the conventional air combustion system without CO2 recovery, the present system is as low as 30.9% in it because of CO2 recovery but excels the conventional amine absorption system which is 27.8% in it. The annual increase in total expenses inclusive of both installation and operation costs for the CO2 recovery in the present system is smaller than that in the amine absorption system. 4 refs., 1 fig., 2 tabs.

24265 (CONF-9207203–, pp. 55-58) **Present status and future aspects of combustion technologies to establish the advanced utilization of thermal energy.** Otake, K. (Toyohashi University of Technology, Aichi (Japan)). 22 Jul 1992. 320p. (In Japanese). From 1. meeting of The Japan Institute of Energy and the 70th Foundation anniversary meeting; Tokyo (Japan); 22-24 Jul 1992. In *Proceedings of the 1st Meeting of the Japan Institute of Energy and the 70th Foundation Anniversary Meeting.* Order Number DE93793523. Source: OSTI; NTIS (US Sales Only).

Combustion technologies were studied for the high degree utilization of thermal energy. Energy systems being presently used are of a type which stands alone and most of them are low in utilization efficiency. The water heating, air conditioning, cooking, etc. use 20 to 25% of the fossil fuel in the form of high temperature combustion heat which is released as waste heat after utilized. The transportation uses 16% of all the primary energy however mostly through the internal combustion engines which are low in thermal efficiency. Problem is also about their exhaust gas. The power generation uses 42% of all the primary energy (32% by fossil fuel, 9% by nuclear energy and 1% by others). Their efficiency which is 48% even by combined cycle must be designed to be higher than 80% by cogeneration, etc. The use of fuel cell is also promising. It is also important to recycle the waste as energy to be reused. Based on a new concept upon thorough review of the present material and energy systems, development must be spread out of combustion technologies which contribute to the high degree utilization of thermal energy and environmental purification.

24266 (CONF-9207203–, pp. 59-64) **Combustion technology in industrial furnaces.** Suzuki, T. (Kobe Steel, Ltd., Kobe (Japan)). 22 Jul 1992. 320p. (In Japanese). From 1. meeting of The Japan Institute of Energy and the 70th Foundation anniversary meeting; Tokyo (Japan); 22-24 Jul 1992. In *Proceedings of the 1st Meeting of the Japan Institute of Energy and the 70th Foundation Anniversary Meeting.* Order Number DE93793523. Source: OSTI; NTIS (US Sales Only).

Combustion by industrial furnaces produces carbon dioxide which quantitatively occupies 33% of that produced in all over Japan. Study was made of carbon dioxide control with saving the energy. Because the exhaust heat recovery by heat exchanger needed an expensive and large installation, design was made of a compact unit, to the burner body of which a heat exchanging function was given. In the heat recuperative burner, heat exchange is done between the combustion use air and exhaust combustion gas which is made to flow in an annular passage around the burner. Thus, more than 30% of fuel can be economized. Provided with a heat regenerator, the heat regenerative burner continues combustion by reciprocally switching the ventilation and gas exhaust. There exists The one which is as high as 48% in fuel economizing ratio. In the thermal treatment of steel by the direct fire reduction heating furnace, reduction is done by flame in a non-equilibrated region where the air ratio is 0.8 to 0.9. As compared with that by the conventional radiant tube type furnace, the above treatment is improved in both thermal respondency and plate's adoption time, and saves the energy. The system which blows pulverized coal, in lieu of coke, from a lower tuyere of blast furnace does not need coke oven, economizes the carbonization heat and quantitatively reduces the carbon dioxide. The above system is introduced to 80% of the blast furnaces presently under operation in Japan. 16 refs., 14 figs.

24267 (DOE/FTR–93013557) **[Travel to Lisbon, Portugal to present a paper at the sixth international symposium of applications of laser techniques to fluid mechanics and travel to Cambridge University to visit the Shell Thornton Research Centre]: Foreign trip report, July 18–29, 1992.** Witze, P.O. Sandia National Labs., Livermore, CA (United States). 28 Aug 1992. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DR00789. Order Number DE93013557. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The author's paper presented at this symposium related to homogeneous- charge combustion in a spark ignition engine. Although most of the other papers were related to techniques and applications of laser Doppler velocimetry and phase-Doppler particle analyzers, there were four sessions on particle image velocimetry and two sessions on scalar measurements. In the topical areas there were two combustion sessions, two reciprocating engine sessions, and one session on sprays. The manufacturer's display at the symposium continued to grow. A secondary purpose of the trip was to visit the engine research facilities of the Shell

Thornton Research Centre, Leeds University, Loughborough University of Technology, and Cambridge University.

24268 (EGG-M–92069) **Post combustion trials at Dofasco's KOBM furnace.** Farrand, B.L.; Wood, J.E.; Goetz, F.J. Dofasco, Inc., Hamilton, ON (Canada). [1992]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-76ID01570. (CONF-9204236–1: 75. ISS-AIME steelmaking conference, Toronto (Canada), 5-8 Apr 1992). Order Number DE93010804. Source: OSTI; NTIS; GPO Dep.

Post combustion trials were conducted at Dofasco's 300 tonne KOBM furnace as part of the AISI Direct Steelmaking Program. The purpose of the project work was to measure the post combustion ratio (PCR) and heat transfer efficiency (HTE) of the post combustion reaction in a full size steelmaking vessel. A method of calculating PCR and HTE using off gas analysis and gas temperature was developed. The PCR and HTE were determined under normal operating conditions. Trials assessed the effect of lance height, vessel volume, foaming slag and pellet additions on PCR and HTE.

4220 Mining and Underground Engineering

24269 **Downhole material injector for lost circulation control.** Glowka, D.A. To Dept. of Energy. 1991. Filed date 17 Apr 1991. USA patent application 7-686,442. 25p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. Order Number DE93012018. Source: OSTI; NTIS; GPO Dep.

This invention is comprised of an apparatus and method for simultaneously and separately emplacing two streams of different materials through a drillstring in a borehole to a downhole location for lost circulation control. The two streams are mixed outside the drillstring at the desired downhole location and harden only after mixing for control of a lost circulation zone.

4230 Marine Engineering

24270 (AUC-IBT-R–9240) **Optimal inspection strategies for offshore structural systems.** Structural Reliability Theory Paper, 96. Faber, M.H.; Soerensen, J.D.; Kroon, I.B. Aalborg Universitetscenter (Denmark). Inst. for Bygningsteknik. Dec 1992. 16p. (CONF-9209358–1: OMAE'92 conference, Calgary (Canada), Sep 1992). Order Number DE93794732. Source: OSTI; NTIS.

Optimal planning of inspection and maintenance strategies for structures has become a subject of increasing interest especially for offshore structures for which large costs are associated with structural failure, inspections and repairs. During the last five years a methodology has been formulated to perform optimal inspection and repair strategies for structural components subject to incertain loading conditions and material behavior. This methodology makes it possible to determine an inspection and repair plan which will minimize the total expected costs of a component throughout its anticipated lifetime. The expected costs are calculated as the product of the probability of the event (e.g. repair) and the cost of the event. Only recently the authors have extended this methodology to include also system failure i.e. failure of a given sub set of all the structural components. This extension includes first of all a mathematical framework for the estimation of the failure and repair costs associated with systems failure but also and not least a strategy for selecting the components to inspect. The present paper is concerned about the application of this extended methodology in the case of offshore structures. First a detailed description of the method is presented and thereafter special interest is paid to the problem of selecting structural components to inspect. Methods and analysis schemes are illustrated by an example. (au) (15 refs.).

24271 (AUC-IBT-R–9241) **Reliability analysis of an offshore structure: A case study - 1.** Structural Reliability Theory Paper, 97. Faber, M.H. (University of Aalborg, Aalborg (Denmark)); Soerensen, J.D.; Rackwitz, R.; Thoft-Christensen, P.; Bryla, P. Aalborg Universitetscenter (Denmark). Inst. for Bygningsteknik. Dec 1992. 16p. (CONF-9209358–2: OMAE'92 conference, Calgary (Canada), Sep 1992). Order Number DE93794733. Source: OSTI; NTIS.

A jacket type offshore structure from the North Sea is considered. The time variant reliability is estimated for failure defined as brittle fracture and crack through the tubular member walls. The stochastic modelling is described. The hot spot stress spectral moments as function of the stochastic variables are described using spline function response surfaces. A Laplace integral expansion is used to estimate the time variant reliability. Parameter studies are performed for the reliability estimates and the results of the time variant and the time invariant reliability analyses are compared. (au).

24272 (AUC-IBT-R–9242) **Reliability analysis of an offshore structure: A case study - 2.** Structural Reliability Theory Paper, 98. Soerensen, J.D. (University of Aalborg, Aalborg (Denmark)); Faber, M.H.; Rackwitz, R.; Thoft-Christensen, P.; Lebas, G. Aalborg Universitetscenter (Denmark). Inst. for Bygningsteknik. Dec 1992. 15p. (CONF-9209358–: OMAE'92 conference, Calgary (Canada), Sep 1992). Order Number DE93794734. Source: OSTI; NTIS.

For an offshore structure in the North Sea it is assumed that information from measurements and inspections is available. As illustrations measurements of the significant wave height and the marine growth and different inspection and repair results are considered. It is shown how the reliability estimates of the structure can be updated using Bayesian techniques. By minimizing the total expected costs including inspection, repair and failure costs during the lifetime an optimal inspection and repair strategy can be determined. The decision variables are the number of inspections, the time intervals between inspections and the inspection qualities. A parameter study is performed and an updated inspection plan is determined after the first inspection has taken place. (au) (12 refs.).

24273 (CONF-921276–, pp. 203-206) **Development of automatic observation system for oceanographic and meteological data powered by solar and wave energy for Oki-no-Torishima Island.** Washio, Y. (Japan Marine Science and Technology Center, Kanagawa (Japan)); Miyazaki, T. 3 Dec 1992. 305p. (In Japanese). From 1992 Japan Solar Energy Society, Japan Wind Energy Association joint converence; Osaka (Japan); 3-4 Dec 1992. In *1992 JSES (Japan Solar Energy Society)/JWEA (Japan Wind Energy Association) Joint Conference.* Order Number DE93793955. Source: OSTI; NTIS (US Sales Only).

This paper describes development of automatic observation devices of self energy supply type for maintenance-free and unattended oceanographic observation at Oki-no-Torishima Island. All power for the devices is supplied from a battery. While a charging system charges the battery continuously, a 12V-battery with a capacity of 80 Ah was selected that can supply power for a two-week operation assuming a possible failure. Small wave force power generators and solar cells were adopted for the charging system from the viewpoint of smallness in the scale, little failure factors, and easiness of installation. The wave force power generation used a vibration column type air turbine generator and a wells turbine direct connection generator. The solar cells have an output capacity of 80W, given with consideration on water resistance and durability. The wave force power generator has been operating without a trouble for two years since 1989 except for rusting in the air chambers. However, wave heights were reduced largely because of the surrounding reefs, making the power generation system unsuitable in terms of the cost. The solar cell system has been operating under sufficient insolation for charging the battery, with the light receiving face kept uncontaminated. The system reasonability was verified as in the wave force power generation as far as the design and installation methods are concerned. 9 refs., 8 figs.

4250 Power Cycles

Refer also to citation(s) 24563

4260 Components, Electron Devices and Circuits

Refer also to citation(s) 23182, 23514, 23754, 23830, 23841, 23842, 23983, 24014, 24050, 24088, 24267, 24425, 24472, 24476, 24489, 24496, 24524, 24556, 25324, 25327

24274 (ENEA-RT-INN–92-04) **Contributions to 14th international conference on laser and application: (San Diego, CA, 8-13/12/1991).** ENEA, Frascati (Italy). Dipt. Sviluppo Tecnologie di Punta. Apr 1992. 22p. (CONF-911296–: 14. international conference on laser and applications, San Diego, CA (United States), 8-13 Dec 1991). Order Number DE93000814. Source: OSTI; NTIS (US Sales Only).

Separate abstracts have been prepared for the individual papers in this report.

24275 (ENEA-RT-INN–92-04, pp. 15-22) **High brightness large aperture excimer laser radiation.** Bollanti, S.; Di Lazzaro, P.; Giordano, G.; Flora, F.; Letardi, T.; Schina, G.; Portaccio, M.; Torre, A.; Zheng, C.E. ENEA, Frascati (Italy). Dipt. Sviluppo Tecnologie di Punta. Apr 1992. (CONF-911296–: 14. international conference on laser and applications, San Diego, CA (United States), 8-13 Dec 1991). In *Contributions to 14th international conference on laser and applications: (San Diego, CA, 8-13/12/1991).* 22p. Order Number DE93000814. Source: OSTI; NTIS (US Sales Only); INIS.

Particular technologies, like soft X-ray beams generation by laser-matter interaction for X-ray lithography or biological X-ray diagnostics, require laser beams having a very high intensity ($>10^{10}$ W-cm^2) and possibly a short wavelength (for higher radiation-to-matter matching). For such purposes, excimer lasers are the best candidates since they represent the highest powerful coherent sources in the U.V. range. In spite of their short pulse duration (10^{-8}-/10^{-7} s), they provide a very high gain of the active medium and consequently unstable resonators, characterized by fast transverse modes selection with high losses, can be applied. Here a high magnification (M=7) Positive Branch Unstable Resonator (PBUR) has been successfully applied to a wide aperture (10x10 cm^2) XeCl laser, leading to a laser beam divergence of 14 prad PWEM (3 times the diffraction limit) and a brightness of about 10^{15} W-(cm^2 srad). The experimental results are investigated by means of analytical considerations and a numerical simulation. This paper describes first the guide-lines for the choice of the resonator, then the experimental results and finally the simulation code.

24276 (ENEA-RT-INN–92-04, pp. 5-14) **Theoretical study of prepulse-main discharge XeCl lasers.** Letardi, T.; Fang, H.; Flora, F.; Fu, S. ENEA, Frascati (Italy). Dipt. Sviluppo Tecnologie di Punta. Apr 1992. (CONF-911296–: 14. international conference on laser and applications, San Diego, CA (United States), 8-13 Dec 1991). In *Contributions to 14th international conference on laser and applications: (San Diego, CA, 8-13/12/1991).* 22p. Order Number DE93000814. Source: OSTI; NTIS (US Sales Only); INIS.

To achieve high energy deposition efficiency of discharge pumped XeCl lasers, the energy storage capacitor should be charged to a voltage about two times of the self-sustained voltage of the laser system. Unfortunately, this voltage is too low to initiate a uniform glow discharge. To speed up the avalanche process, prepulse-main discharge technique was proposed in which, a high voltage breakdown pulse and a sustaining pulse are provided by separate circuits. In this paper, the discharge characteristics of prepulse-main discharge XeCl lasers and the effects of prepulse circuit parameters are investigated by means of a kinetic code. The modeling shows that an appropriately designed prepulse circuit could speed up the breakdown process effectively. The key point for this technique is to design a prepulse circuit which multiplies the electron density from its initial value to about 10^{14}-cm^3 in a reasonable short time during which the main discharge circuit is disconnected from the electrodes. Optimum values of capacitance, charge voltage of the prepulse circuit, delay time between prepulse and main discharge for energy deposition efficiency, XeCl formation efficiency and laser performance are also investigated.

24277 (GA-A–21236) **User's manual for the DAD-1 data acquisition daughter board for the SuperCard-2.** Ferron, J.R. General Atomics, San Diego, CA (United States). May 1993. 45p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-89ER51114. Order Number DE93012153. Source: OSTI; NTIS; GPO Dep.

A detailed description of how to use the DAD-1 data acquisition daughter board is given. The DAD-1 daughter board is used with the SuperCard-2, a VME format processor board manufactured by CSP Inc. that is based on the Intel i860 microprocessor. The daughter board provides high speed acquisition of digital data through a general purpose input port. Data are transferred through direct memory access operations to the memory on the SuperCard-2 board at a rate up to 40 million, 14 bit samples per second. A first-in, first-out memory is used to buffer the data during the transfer. Several different data acquisition operating modes are available that make a combination of a SuperCard-2 processor board and a DAD-1 daughter board suitable for a wide range of real time data analysis and feedback control functions.

24278 (LA-SUB–93-168) **Metal oxide varistor feasibility study.** Levinson, L.M. (General Electric Co., Schenectady, NY (United States). Corporate Research and Development Dept.); Comanzo, H.A. Los Alamos National Lab., NM (United States); General Electric Co., Schenectady, NY (United States). Corporate Research and Development Dept. [1993]. 34p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. Order Number DE93012921. Source: OSTI; NTIS; GPO Dep.

We have successfully fabricated varistor material meeting the initial voltage stabilization specifications for the Dual Axis Radiographic Hydratest (DARHT) facility. A time dependent voltage droop ("overshoot") has been identified as a potential issue and some promising avenues to reduce the overshoot are outlined. In particular, preliminary tests using series capacitance gives an overshoot of a few percent. These data, coupled with our previous experience on low-overshoot varistor formulations, lead to the conclusion that specially tailored varistor material might be suitable for the DARHT application.

24279 Cavity resonance absorption in ultra-high bandwidth CRT deflection structure. Dunham, M.E.; Hudson, C.L. To Dept. of Energy. 15 May 1991. USA patent application 7-700,286. 23p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC08-88NV10617. Order Number DE93012002. Source: OSTI; NTIS; GPO Dep.

An improved ultra-high bandwidth helical coil deflection structure for a cathode ray tube is described comprising a first metal member having a bore therein, the metal walls of which form a first ground plane; a second metal member coaxially mounted in the bore of the first metal member and forming a second ground plane; a helical deflection coil coaxially mounted within the bore between the two ground planes; and a resistive load disposed in one end of the bore and electrically connected to the first and second ground planes, the resistive load having an impedance substantially equal to the characteristic impedance of the coaxial line formed by the two coaxial ground planes to inhibit cavity resonance in the structure within the ultra-high bandwidth of operation. Preferably, the resistive load comprises a carbon film on a surface of an end plug in one end of the bore.

24280 Ring regenerative laser amplifier. Perry, M.D.; Patterson, F.G. To Dept. of Energy. 1991. Filed date 22 May 1991. USA patent application 7-704,590. 45p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE93011997. Source: OSTI; NTIS; GPO Dep.

This invention consists of an efficient, high gain, compact regenerative amplifier that amplifies a seed pulse of laser energy to produce an amplified pulse of greater energy. The amplifier is useful for amplifying seed pulses having a broad bandwidth or in situations where tunability is necessary. The amplifier has high gain while maintaining high pulse contrast. A seed pulse can be amplified to the saturation fluence while maintaining a high contrast ($>10^3$). The regenerative amplifier has an optical cavity in a ring configuration, a gain material positioned in the cavity, a polarization-rotating element positioned in the cavity to rotate the polarization of the pulse upon each pass around the cavity, means for inserting the seed pulse into the cavity, and means for removing the polarization-rotated, amplified pulse from the cavity. In some embodiments, the seed pulse is switched in passively, by a selective polarization, and is switched out after a predetermined number of passes around the ring cavity. This completely passive arrangement avoids possibility of switchout failure, and minimizes the ASE problem. In other embodiments, a selectively actuable switch, such as electro-optic element, may be provided within the

ring cavity, to switch-in the seed pulse and switch-out the amplified pulse. The electro-optic element may be actuated with a square wave that has a peak voltage equal to the half-wave voltage of the electro-optic crystal.

24281 (SAND–92-2804C) **High power z pinches as x-ray laser photopumps.** Nash, T.J.; Spielman, R.B.; Ruggles, L.; Vargas, M. Sandia National Labs., Albuquerque, NM (United States). [1992]. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-9304126–6: 3. international conference on dense z-pinches, London (United Kingdom), 19-23 Apr 1993). Order Number DE93012842. Source: OSTI; NTIS; GPO Dep.

Using Saturn as a driver, we are pursuing both photoresonantly pumped and photoionization/recombination lasers. Our lasing targets are gas cells with thin windows that are pumped by a z pinch 2 cm away radiating 10 TW. In both schemes the lasant and gas fill is neon. To increase our chances of measuring the resonantly photopumped lasing transition we have introduced potassium into a sodium z pinch and have eliminated oxygen from the gas cell windows. We have measured the spatial dependence of ionization balance across the gas cell, and this measurement is consistent with propagation of a shock front across the gas cell target. We have measured blue-shifted satellites to several Li-like neon transitions that may indicate return-current driven jetting a high 1.5e8 cm/sec velocity. Using a gold z-pinch we have shown that key radiation is necessary to excite the He-like lines of neon. An attempt at a single shot gain measurement also indicates that radiation is not the only source of gas cell heating.

24282 (SAND–92-7284) **Measurements and analysis of the equivalent circuit of the GEC RF Reference Cell.** Verdeyen, J.T. (Illinois Univ., Urbana, IL (United States). Dept. of Electrical and Computer Engineering). Sandia National Labs., Albuquerque, NM (United States); Illinois Univ., Urbana, IL (United States). Dept. of Electrical and Computer Engineering. Sep 1992. 37p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. Order Number DE93013498. Source: OSTI; NTIS; INIS; GPO Dep.

The equivalent circuit of the GEC RF Reference Cell is determined by the use of a vector impedance meter and reported here. The measurement procedure and data reduction techniques are discussed and typical data are presented from which the component values are determined. Once the circuit is established, one can use it to define the ABCD parameters of the Cell which relate the terminal measurements to those at the plasma. A significant and as yet unresolved question is emphasized: namely, "what is the path for the rf current?" An experimental procedure for answering this question is suggested, but there does not appear to be a simple "plasma" reason for the answer. To obtain such an answer is a challenge to the experimenters and modelers. While the emphasis is on the GEC RF Reference Cell, the procedure, data reduction techniques, and "the question" are pertinent to all reactors.

24283 (SAND–93-0037C) **1/f noise and oxide traps in MOSFETs.** Fleetwood, D.M. (Sandia National Labs., Albuquerque, NM (United States)); Meisenheimer, T.L.; Scofield, J.H. Sandia National Labs., Albuquerque, NM (United States). [1993]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-930866–1: 12. international conference on noise in physical systems and 1/f fluctuations, St. Louis, MO (United States), 16-20 Aug 1993). Order Number DE93007581. Source: OSTI; NTIS; GPO Dep.

MOSFETs historically have exhibited large 1/f noise magnitudes because of carrier-defect interactions that cause the number of channel carriers and their mobility to fluctuate. Uncertainty in the type and location of defects that lead to the observed noise have made it difficult to optimize MOSFET processing to reduce the level of 1/f noise. This has limited one's options when designing devices or circuits (high-precision analog electronics, preamplifiers, etc.) for low-noise applications at frequencies below ~10–100 kHz. We have performed detailed comparisons of the low-frequency 1/f noise of MOSFETs manufactured with radiation-hardened and non-radiation-hardened processing. We find that the same techniques which reduce the amount of MOSFET radiation-induced oxide-trap charge can also proportionally reduce the magnitude of the low-frequency 1/f noise of both unirradiated and irradiated devices. MOSFETs built in radiation-hardened device technologies show noise levels up to a factor of 10 or more lower than standard commercial MOSFETs of comparable dimensions, and our quietest MOSFETs show noise magnitudes that approach the low noise levels of JFETS.

24284 (SAND–93-0436C) **Surface-emitting laser-based optical switching: An update.** Zhou, P. (New Mexico Univ., Albuquerque, NM (United States). Center for High Technology Materials); Cheng, J.; Sun, S.Z.; Hersee, S.; Osinski, M.; Zolper, J.; Meyers, D.R.; Vawter, G.A. Sandia National Labs., Albuquerque, NM (United States). [1993]. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-930135–4: International symposium on advanced electronic and optoelectronic materials, Los Angeles, CA (United States), 20-23 Jan 1993). Order Number DE93010689. Source: OSTI; NTIS; GPO Dep.

The properties of vertical-cavity surface-emitting lasers (VCSELS) and VCSEL-based optical switches using MOCVD-grown epitaxial material are discussed and sum their performance.

24285 (SAND–93-1006C) **Design and testing of planar magnetic micromotors fabricated by deep x-ray lithography and electroplating.** Guckel, H. (Wisconsin Univ., Madison, WI (United States). Dept. of Electrical and Computer Engineering); Christenson, T.R.; Skrobis, K.J.; Klein, J.; Karnowsky, M. Sandia National Labs., Albuquerque, NM (United States). [1993]. 5p. Sponsored by USDOE, Washington, DC (United States); Department of Defense, Washington, DC (United States); National Science Foundation, Washington, DC (United States). DOE Contract AC04-76DP00789. Grant EET-8815285;Grant 88-MC-507;Grant N00014-91-J-1876;Grant D (CONF-9305186–1: 7. international conference on solid state sensors and actuators, No City Given (Japan), 13-15 May 1993). Order Number DE93012856. Source: OSTI; NTIS; GPO Dep.

The successful design and testing of a three-phase planar integrated magnetic micromotor is presented. Fabrication is based on a modified deep X-ray lithography and electroplating or LIGA process. Maximum rotational speeds of 33,000 rpm are obtained in air with a nxor diameter of 285 μm and do not change when operated in vacuum. Real time rotor response is o with an integrated shaft encoder. Long lifetime is evidenced by testing to over $5(10)_7$ ration cycles without changes in performance. Projected speeds of the present motor configuration am in the vicinity of 100 krpm and are limited by torque ripple. Higher speeds, which are attractive for sensor applications. require constant torque characteristic excitation as is evidenced by ultracentrifuge and gyroscope design. Further understanding of electroplated magnetic material properties will drive these performance improvements.

24286 (UCRL-CR–109734) **DMS project, attachment 1: Final report and user's manual for the Analog and Driver Breadboard and Test Set.** Lawrence Livermore National Lab., CA (United States); Fairchild Space Co., Germantown, MD (United States). [1993]. 79p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE93014110. Source: OSTI; NTIS; GPO Dep.

The LLNL/DMS Analog and Driver boards implement a variety of functions. The Analog section (card A1) provides excitation to 3 hot wire gyros, 3 accelerometers, 4 thermistors. The A1 card also collects telemetry on the above plus the primary power system (a solar cell array, NiCd and $LiSO_2$ batteries). The driver circuitry (card A2) provides the power section to the circuitry which controls the valves. A separate Test Set card (A3) exercises the other 2 cards. This final report and user's manual provides the circuit schematics for the DMS Analog, Driver, and Test Set. The Analog and Driver circuitry has been tested using the Test Set. All functions have been verified, and where possible, accuracy and noise have been measured. The results of these tested are included in this report.

24287 (UCRL-JC–110974) **Selenium x-ray laser line profile measurements.** Koch, J.A. (Lawrence Livermore National Lab., CA (United States)); MacGowan, B.J.; Da Silva, L.; Matthews, D.L.; Mrowka, S.; Underwood, J.H.; Batson, P.J. Lawrence Livermore

National Lab., CA (United States). 8 Jul 1992. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48 ;AC03-76SF00098. (CONF-920523–10: 3. international colloquium on x-ray lasers, Schliersee (Germany), 18-22 May 1992). Order Number DE93012580. Source: OSTI; NTIS; INIS; GPO Dep.

We discuss our recent measurements of the spectral width of the 206.38 Å laser in Ne-like Se. These measurements were performed over a wide range of amplifier length indicate an intrinsic line width of 50 mÅ FWHM (full-width at half-maximum), show gain narrowing to 10 mÅ in intermediate length amplifiers and show no significant re-broadening in We briefly discuss the experiments and interpretations.

24288 (UCRL-JC–111233) **Oscillator-amplifier experiments in neon-like yttrium.** Shimkaveg, G.M.; Carter, M.R.; Walling, R.S.; Ticehurst, J.M.; London, R.R; Stewart, R.E. Lawrence Livermore National Lab., CA (United States). 24 Jul 1992. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-920523–13: 3. international colloquium on x-ray lasers, Schliersee (Germany), 18-22 May 1992). Order Number DE93012577. Source: OSTI; NTIS; GPO Dep.

We present the first results from spatially and temporally separated x-ray lasing plasmas, shot sequentially with the emission of the first directed into the second.

24289 (UCRL-JC–111392) **Spatial coherence of soft x-ray lasers.** Trebes, J. Lawrence Livermore National Lab., CA (United States). 3 Aug 1992. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-920523–11: 3. international colloquium on x-ray lasers, Schliersee (Germany), 18-22 May 1992). Order Number DE93012497. Source: OSTI; NTIS; GPO Dep.

Short communication. X-RAY LASERS/beam optics; COHERENT RADIATION

24290 (UCRL-JC–111712) **Wavelength considerations in soft x-ray projection lithography.** Hawryluk, A.M.; Ceglio, N.M. Lawrence Livermore National Lab., CA (United States). 4 Aug 1992. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9204120–8: Soft-x-ray projection lithography topical meeting, Monterey, CA (United States), 6-8 Apr 1992). Order Number DE93014115. Source: OSTI; NTIS; GPO Dep.

The choice of the operational wavelength for a SXPL system will affect a wide variety of system parameters such as optical design, sources, resists, multilayer mirrors, etc. Several system constraints limit the choice for the operational wavelength. In particular, optical imaging requirements place an upper limit and throughput issues place a lower limit on the wavelength selection. The authors have determined that there exist several discrete wavelength regions between 10 and 25 nm which satisfy the system imposed constraints of high resolution, large depth of focus and high throughput.

24291 (UCRL-JC–111714) **Reflection mask defect repair.** Hawryluk, A.M. (Lawrence Livermore National Lab., CA (United States)); Stewart, D. Lawrence Livermore National Lab., CA (United States). Sep 1992. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9204120–7: Soft-x-ray projection lithography topical meeting, Monterey, CA (United States), 6-8 Apr 1992). Order Number DE93014113. Source: OSTI; NTIS; GPO Dep.

The authors have developed a new technique for the repair of opaque defects on soft x-ray projection lithography reflection masks using ion beam etching and a thin silicon overcoat on the multilayer mirror. This technique clears the defect without damaging the multilayer mirror or introducing an absorptive element into the multilayer. The procedure uses a beam of "low" atomic number ions (Si or Ar) of reduced beam energy, and a thin Si overcoat to protect the multilayer mirror.

24292 (UCRL-JC–111945) **Kinetics of high concentration arsenic deactivation at moderate to low temperatures.** Luning, S. (Stanford Univ., CA (United States). Center for Integrated Systems); Rousseau, P.M.; Griffin, P.B.; Plummer, J.D.; Carey, P.G. Lawrence Livermore National Lab., CA (United States). 14 Oct 1992. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-921204–2: International electron devices meeting, San Francisco, CA (United States), 6-9 Dec 1992). Order Number DE93013349. Source: OSTI; NTIS; GPO Dep.

This work investigates the kinetics of arsenic deactivation at temperatures from 500 to 800°C and for concentrations between 1 x 10^{20} and 1 x $10^{21}/cm^3$. Using profiles created by repeated laser melt annealing, the authors determine mobility as a function of both active and inactive dopant concentration and then characterize the dynamics of carrier deactivation. Retrograde resistivity versus concentration was observed at high doses, which is explained by a mobility reduction due to the inactive arsenic and by retrograde electrical activity of the dopant itself.

43 PARTICLE ACCELERATORS

Refer also to citation(s) 24895, 25382

24293 (BNL–48675) **Magnetic performance of a fast excitation wiggler.** Gallardo, J.C.; Romano, T.; van Steenbergen, A. Brookhaven National Lab., Upton, NY (United States). Mar 1993. 18p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. Order Number DE93013150. Source: OSTI; NTIS; INIS; GPO Dep.

With the objective of performing an inverse free-electron laser accelerator experiment, an iron dominated (Vanadium Permendur), fast excitation, high K planar wiggler has been built and measured. The authors present in this report an analysis of a constant period wiggler and several tapering configurations (gap=4 mm; 3.0 cm < λ_w < 5. cm) when they are driven to a peak field of $B_{max} \approx 1.4$ T.

24294 (DOE/ER/40731–1) **Microwave and accelerator research: Annual report, June 1, 1992.** Nation, J.A. Cornell Univ., Ithaca, NY (United States). [1993]. 18p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-92ER40731. Order Number DE93014087. Source: OSTI; NTIS; INIS; GPO Dep.

This report describes work carried out on DOE grant number DE-FG02- 92ER40731 during the period June 1, 1992 to the present. The report provides a brief summary of the program objectives, summarizes the main accomplishments and concludes with listings of conference and refereed publications.

24295 (UCRL-JC–110204) **Induction technology optimization code.** Caporaso, G.J.; Brooks, A.L.; Kirbie, H.C. Lawrence Livermore National Lab., CA (United States). 21 Aug 1992. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9208109–87: 16. international LINAC conference, Ottawa (Canada), 23-28 Aug 1992). Order Number DE93013415. Source: OSTI; NTIS; GPO Dep.

A code has been developed to evaluate relative costs of induction accelerator driver systems for relativistic klystrons. The code incorporates beam generation, transport and pulsed power system constraints to provide an integrated design tool. The code generates an injector/accelerator combination which satisfies the top level requirements and all system constraints once a small number of design choices have been specified (rise time of the injector voltage and aspect ratio of the ferrite induction cores, for example). The code calculates dimensions of accelerator mechanical assemblies and values of all electrical components. Cost factors for machined parts, raw materials and components are applied to yield a total system cost. These costs are then plotted as a function of the two design choices to enable selection of an optimum design based on various criteria. The Induction Technology Optimization Study (ITOS) was undertaken to examine viable combinations of a linear induction accelerator and a relativistic klystron (RK) for high power microwave production. It is proposed, that microwaves from the RK will power a high-gradient accelerator structure for linear collider development. Previous work indicates that the RK will require a nominal 3-MeV, 3-kA electron beam with a 100-ns flat top. The proposed accelerator-RK combination will be a high average power system capable of sustained microwave output at a 300-Hz pulse repetition frequency. The ITOS code models many combinations of injector, accelerator, and pulse power designs that will supply an RK with the beam parameters described above.

4301 Design, Development, and Operation

Refer also to citation(s) 24344, 24357, 25071, 25322, 25328

24296 (BNL–48346) **Advanced R&D for electron and photon beams at Brookhaven National Laboratory.** Kirk, H.G. Brookhaven National Lab., Upton, NY (United States). Aug 1989. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CAP–92-ATF-89C;CONF-890786–5: US particle accelerator school, Upton, NY (United States), 24 Jul - 4 aug 1989). Order Number DE93010939. Source: OSTI; NTIS; INIS; GPO Dep.

The Brookhaven Accelerator Test Facility consists of a 50-MeV linear accelerator and a laser system capable of generating short (a few picoseconds) laser pulses at both UV (266 nm) and infrared (10 μm) wavelengths. With these systems in place, the ATF has unique capabilities for the study of fundamental interactions between charged-particle beams and intense electromagnetic radiation. The principal research goals of the Accelerator Test Facility (ATF) axe the following. Laser Acceleration Program: We wig study the principles and techniques of particle acceleration at ultra-high frequencies (up to 30 THz) and with very high acceleration gradients (up to 1 GV/m). Production of Coherent Radiation: We wish to develop the next generation of photon sources with features like (a) short pulses (picoseconds or less), (b) coherence, and (c) high peak power. All of these attributes can be provided by free-electron lasers. High-brightness sources: A common denominator for the above programs is the need for electron beams with very small transverse and longitudinal emittances. We will devote a substantial amount of our resources to the production and understanding of electron beams that have these attributes. We will build advanced electron sources such as switched-power devices and rf guns with photocathodes. Important applications of this line of research include the development of high-luminosity linear colliders and free-electron lasers in the XUV regime.

24297 (BNL–48604) **The ADRIA project for high intensity radioactive beams production.** Bisoffi, G. (Laboratori Nazionali di Legnari, Legnaro (Italy)); Cavenago, M.; Dainelli, A.; Facco, A.; Fortuna, G.; Lombardi, A.; Moisio, M.F.; Pisent, A.; Spolaore, P.; Tiveron, B.; Ruggiero, A.G.; Tecchio, L. Brookhaven National Lab., Upton, NY (United States). [1992]. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-9203164–3: International workshop on the physics and techniques of secondary nuclear beams, Dourdan (France), 23-25 Mar 1992). Order Number DE93010866. Source: OSTI; NTIS; INIS; GPO Dep.

A proposal of an accelerator complex (ADRIA) for the Laboratori Nazionali di Legnaro (LNL) is described in this report. The main components of the complex are a Heavy Ion Injection system and two rings, a Booster and a Decelerator, both with a maximum rigidity of 22.25 Tm, connected by a Transfer Line where exotic proposal has two main goals consisting in the isotopes are produced and selected. The proposal has two main goals consisting in the acceleration of stable ion species up to kinetic energies of the order of few GeV/u, at a repetition rate of 10 Hz with intensities of about 10^{12} ions per second, for fixed target experiments in nuclear physics and for the production of fully stripped radioactive beams, using particle fragmentation method for nuclear spectroscopy experiments. Fragments are accumulated in the Decelerator, with intensities $10^{8} \div 10^{9}$ ions/s, cooled and delivered at the production energies or decelerated down to energies of few MeV/u, in proximity of the Coulomb barrier.

24298 (BNL–48790) **The design of the MAD Design Program.** Niederer, J. Brookhaven National Lab., Upton, NY (United States). [1992]. 22p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-921077–4: Stability of particle motion in storage rings, Upton, NY (United States), 18-24 Oct 1992). Order Number DE93013343. Source: OSTI; NTIS; INIS; GPO Dep.

The study of long term stability in particle accelerators has long been served by a group of widely circulated computer programs. The progress in these programs has mirrored the growth and versatility in accelerator size, complexity, and purpose, as well as evolving technologies in computing software and hardware. A number of large accelerator projects during the last decade were designed with the aid of physics programs either written for, or tailored for the project at hand, each invariably benefiting from contributions of previous workers. This paper outlines the recent history of of expample of an accelerator lattice model tool kit, the Methodical Accelerator Design (MAD) Program, which has tried to knit together this collective wisdom of the accelerator community, The ideas behind the software design of the program itself are traced here; the accelerator physics contents and origins are thoroughly documented elsewhere. These informal notes have a Brookhaven flavor, in part because of early BNL efforts to generalize the ways that technical problems are organized and presented to computers. Some recent BNL applications not covered in the extensive CERN documentation are also included.

24299 (BNL–70199) **[Electron-proton collision physics]: Foreign trip report, July 18, 1992–August 1, 1992.** Weng, Wu-Tsung. Brookhaven National Lab., Upton, NY (United States). 27 Aug 1992. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. Order Number DE93012121. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The traveler learned from the international conference that HERA started its electron-proton collision physics run in June, 1992; that a major push for future linear colliders has taken place in various laboratories around the world; and that harmonic cavities can help in both space charge tune shift and transition crossing in a proton synchrotron. The visit to CERN brought the traveler up to date on the operational status and goals of the LEP collider and the design of the LHC for both proton and heavy ion physics. During the visit to Orsay, the traveler learned about the rich history and accomplishments of LAL at Orsay, the status of synchrotron radiation research at LURE, and the free electron laser progress of CLIO. This knowledge and the information gained from the whole trip win be extremely useful in preparing the AGS for both high intensity proton running and for heavy ion injection into MIC.

24300 (INIS-RU–343, pp. 74-79) **Automated control system in charged particle accelerators.** Vit'ko, V.I. (AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst.); Goncharov, I.G.; Kovalenko, G.D. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (Russian Federation). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i; AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1991. [80p.] (In Russian). In *Nuclear-physical researches (Theory and experiment): Scientific-technical collection.* Order Number DE93626131. Source: OSTI; NTIS (US Sales Only); INIS.

A general approach to the design of automated radiation safety systems at charged particle accelerators is described. Parameters of high-energy electron accelerators of the Kharkov Physics and Engineering Institute are presented. Characteristics of the surrounding radiation fields are given. Ionizing radiation transducers which can be used in automated systems are considered. Local radiation monitoring station based on the LUE-2000 accelerator of the institute is described. 9 refs.; 4 figs.; 1 tab.

24301 (JINR-R–10-91-302) **Automated workstation for MT-25 microtron operator: Conception and principal functions.** Ivanov, V.G.; Nodarse, F.F.; Belov, A.G.; Zun'iga, Kh. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of Computing Techniques and Automation. 1991. [16p.] (In Russian). Order Number DE93626132. Source: OSTI; NTIS (US Sales Only); INIS.

The goal of this paper is to create a AHM MT-25 Automated workstation in order to help microtron operator in the preparation, start, technical fault search and adjust, use, turn off and maintenance processes. The ARM MT-25 requirements are personal computer, compatible with IBM PC XT/AT with at least 640 RAM, medium resolution graphic display, hard disk and DOS 3.3 operating system. 4 refs.; 8 figs.

24302 (JINR-R–16-92-36) **Reference neutron fields for metrology of radiation monitoring.** Alejnikov, V.E.; Bamblevskij, V.P.; Komochkov, M.M.; Krylov, A.R.; Mokrov, Yu.V.; Timoshenko, G.N. Joint Inst. for Nuclear Research, Dubna (Russian Federation).

1992. [12p.] (In Russian). Order Number DE93626133. Source: OSTI; NTIS (US Sales Only); INIS.

The set of reference neutron fields created in the JINR for metrology of radiation monitoring is described. The set comprises reference fields based on Cf-252 in polyethylene moderators with diameters 12.7 cm and 29.2 cm and two reference fields based on 660 MeV Laboratory of Nuclear Problems phasotron. 11 refs.; 7 figs.; 1 tab.

24303 (LA-UR–93-1872) **Special design problems and solutions for high powered continuous duty linacs.** Liska, D. (Los Alamos National Lab., NM (United States)); Carlisle, L.; McCauley, G.; Ellis, S.; Ilg, T.; Smith, P. Los Alamos National Lab., NM (United States); Grumman Aerospace Corp., Bethpage, NY (United States). [1993]. 4p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract W-7405-ENG-36. Order Number DE93014476. Source: OSTI; NTIS; GPO Dep.

Several high powered linac designs are being considered for various purposes including radioactive waste treatment, tritium production, and neutron factories for materials studies. Since the fractional beam losses must be in the 10^{-5} to 10^{-6} range and are clearly subject to operational variables, the design engineers are forced to develop concepts which combine maintainability under radioactivity conditions, high availability, and very high reliability while dealing with the operating parameters resulting from CW operation. Several design solutions to selected problems are presented.

24304 (ORNL/FTR–4276) **[Travel to Italy, Switzerland, and Germany for meetings on electrostatic accelerator and associated boosters]: Foreign trip report, May 30, 1992–June 11, 1992.** Olsen, D.K. Oak Ridge National Lab., TN (United States). 25 Jun 1992. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93011064. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The traveler attended the Sixth International Conference on Electrostatic Accelerators and Associated Boosters, Padova, Italy, and presented an invited paper entitled "Opportunities with Radioactive Ion Beams." The traveler also visited the ISOLDE facility, Geneva, Switzerland, to discuss RIB production and the University of Giessen, Giessen, FRG, to discuss high-resolution mass separators. The traveler learned many important details for the ORNL RIB project and obtained a much clearer understanding of the opportunities and problems with RIBs in Europe.

24305 (SSCL-Preprint–323) **Measurements of the ground motion vibrations at the SSC.** Parkhomschuk, V.V.; Shiltsev, V.D.; Weaver, H.J. Superconducting Super Collider Lab., Dallas, TX (United States). May 1993. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-930511–91: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93014084. Source: OSTI; NTIS; INIS; GPO Dep.

The results of seismic ground measurements at the Superconducting Super Collider (SSC) Accelerator Systems String Test (ASST) site are presented. Spectral analysis of the data obtained in a large frequency band from 0.05 Hz to 200 Hz was performed.

24306 (SSCL-Preprint–375) **Dynamic response analysis of the LBL Advanced Light Source synchrotron radiation storage ring.** Leung, K. Superconducting Super Collider Lab., Dallas, TX (United States). May 1993. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-930511–30: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93014180. Source: OSTI; NTIS; INIS; GPO Dep.

This paper presents the dynamic response analysis of the photon source synchrotron radiation storage ring excited by ground motion measured at the Lawrence Berkeley Laboratory advanced light source building site. The high spectral brilliance requirement the photon beams of the advanced light source storage ring specified displacement of the quadrupole focusing magnets in the order of 1 micron in vertical motion.There are 19 magnets supported by a 430-inch steel box beam girder. The girder and all magnets are supported by the kinematic mount system normally used in optical equipment. The kinematic mount called a six-strut magnet support system is now considered as an alternative system for supporting SSC magnets in the Super Collider. The effectively designed and effectively operated six-strut support system is now successfully operated for the Advanced Light Source (ALS) accelerator at the Lawrence Berkeley Laboratory. This paper will present the method of analysis and results of the dynamic motion study at the center of the magnets under the most critical excitation source as recorded at the LBL site.

24307 (SSCL-Preprint–389) **Status of the SSC.** Briggs, R.J. Superconducting Super Collider Lab., Dallas, TX (United States). May 1993. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-930511–16: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93014183. Source: OSTI; NTIS; INIS; GPO Dep.

The Superconducting Super Collider (SSC) is a proton-proton colliding beam accelerator which, when completed, will provide collision energies of 40 TeV in the center-of-mass, at a luminosity of $10^{33}/cm^2/sec^{-1}$. This paper will describe the current status of the design and construction of the project.

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Refer also to citation(s) 24373, 24374, 24381, 24395, 24420, 25221, 25332

24308 (BNL–48676) **Determination of beam position monitor offset in focusing wigglers.** Ben-Zvi, I. (Brookhaven National Lab., Upton, NY (United States)); Hung, Chi-Ming. Brookhaven National Lab., Upton, NY (United States). 25 Sep 1992. 21p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. Order Number DE93014024. Source: OSTI; NTIS; GPO Dep.

In this report the authors study the possibility of determining the offset in beam position-monitoring instruments (e.g. strip-line detectors) by means of changing the natural focusing strength of a planar untapered wiggler. The focusing of the wiggler provides a correlation between the transverse positions of the electron beam at different locations along the wiggler. By varying the strength of the wiggler field, it is possible to deduce the offset in the position monitors through a least square fit. The fitting is relatively straight forward if one has an ideal wiggler field free of error. Existence of wiggler field error introduces new variables into the fitting procedure. It will be shown that one needs a minimum of 2 wiggler field settings for the case without error in the wiggler field, while 4 field settings are required for the case with a particular model of the wiggler field error. The results of numerical simulations suggest that it is possible with this method to determine the offsets to an accuracy comparable with the sensitivity of strip-line monitors (i.e. a few microns).

24309 (BNL–48679) **Ion shaking in the 200 MeV XLS-ring.** Bozoki, E.; Kramer, S.L. Brookhaven National Lab., Upton, NY (United States). [1992]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-920315–47: 3. European particle accelerator conference (EPAC-3): Accelerators for special applications, Berlin (Germany), 24-28 Mar 1992). Order Number DE93014057. Source: OSTI; NTIS; INIS; GPO Dep.

It has been shown that ions, trapped inside the beam's potential, can be removed by the clearing electrodes when the amplitude of the ion oscillation is increased by vertically shaking the ions. We will report on a similar experiment in the 200 Mev XLS ring. The design of the ion clearing system for the ring and the first results obtained, were already reported. In the present series of experiments, RF voltage was applied on a pair of vertical strip-lines. The frequency was scanned in the range of the ion (from H_2 to CO_2) bounce frequencies in the ring (1–10 MHz). The response of the beam size, vertical betatron tune and lifetime was studied.

24310 (BNL–48905) **Bunched beam longitudinal instability: Coherent dipole motion.** Zhang, S.Y.; Weng, W.T. Brookhaven National Lab., Upton, NY (United States). Alternating Gradient Synchrotron Dept. 23 Apr 1993. 28p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016.

(AGS/AD–93-6). Order Number DE93013344. Source: OSTI; NTIS; INIS; GPO Dep.

In this paper, the authors present a new formulation for the longitudinal coherent dipole motion, where a quadrature response of the environmental impedance is shown to be the effective longitudinal impedance for the beam instability. The Robinson-Pedersen formulation for the longitudinal dipole motion is also presented, the difference of the two approaches is discussed in the comparison. The results by using the Sacherer integral equation for the coherent dipole motion can generate the same results as by using the other two approaches, except for a scaling difference. The formulation is further generalized to the rigid bunch motion using signal analysis method, where a form factor shows up naturally. Finally, the formulation is applied to solve the coupled bunch instabilities. Examples of the AGS Booster and the AGS coupled bunch instabilities are used to illustrate the applications of the formulation.

24311 (BNL–48906) **Tevatron studies report.** Jackson, G. (Fermi National Accelerator Lab., Batavia, IL (United States)); McConnell, D.; Fellenz, B.; Raka, E.; Yamin, S.P. Brookhaven National Lab., Upton, NY (United States). 23 Apr 1993. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (AGS/AD–93-4). Order Number DE93013400. Source: OSTI; NTIS; INIS; GPO Dep.

On Wednesday, July 24, 1991, we studied the effectiveness of "constant amplitude" transverse damping at the Fermilab Tevatron. In this mode of damping, whenever a bunch's displacement exceeds a specified threshold, a constant (usually maximum) aplitude correction pulse is applied to the damper kicker. This is in contrast to the "linear" mode, where the kick is proportional to the displacement.

24312 (BNL–48907) **Spectrum analysis in beam diagnostics.** Zhang, S.Y.; Weng, W.T. Brookhaven National Lab., Upton, NY (United States). 23 Apr 1993. 35p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. Order Number DE93013401. Source: OSTI; NTIS; INIS; GPO Dep.

In this article, we discuss fundamentals of the spectrum analysis in beam diagnostics, where several important particle motions in a circular accelerator are considered. The properties of the Fourier transform are presented. Then the coasting and the bunched beam motion in both longitudinal and transverse are studied. The discussions are separated for the signal particle, multiple particle, and the Schottky noise cases. To demonstrate the interesting properties of the beam motion spectrum, time domain functions are generated, and then the associated spectra are calculated and plotted. In order to show the whole picture in a single plot, some data have been scaled, therefore they may not be realistic in an accelerator.

24313 (FNAL/C–92/389) **Operational experience with the Fermilab Linac.** Allen, L.J.; Lennox, A.J.; Schmidt, C.W. Fermi National Accelerator Lab., Batavia, IL (United States). Dec 1992. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03000. (CONF-9208109–81: 16. international LINAC conference, Ottawa (Canada), 23-28 Aug 1992). Order Number DE93011640. Source: OSTI; NTIS; INIS; GPO Dep.

The Fermilab 200-MeV Linac has been in operation for nearly 22 years as a proton injector to the Booster synchrotron. It presently accelerates H^- ions to 200 MeV for charge-exchange injection into the Booster and to 66 MeV for the production of neutrons at the Neutron Therapy Facility. The beam intensity is typically 35 mA with pulse widths of 30 μsec for the Booster for high energy physics and 57 μsec for NTF at a maximum of 15 pulses per sec. During a typical physics run of nine to twelve months, beam is available for greater than 98% of the scheduled time. The Linac history, operation, tuning, stability and reliability will be discussed.

24314 (IFVE-OKU–90-83) **Accelerated beam recapturing in IHEP machine at 33.3 MHz.** Kuznetsov, S.A.; Myaeh, Eh.A.; Nelipovich, E.S.; Pashkov, P.T.; Smirnov, A.V. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov (Russian Federation). Inst. Fiziki Vysokikh Ehnergij. 1990. [15p.] (In Russian). Order Number DE93626147. Source: OSTI; NTIS (US Sales Only); INIS.

Possibilities to form particle bunches in the IHEP machine whose longitudinal parameters would satisfy the requirements imposed by 3x3 TeV p-p program of UNK are studied. The numerical analysis of quasiadiabatic debunching of the accelerated proton beam and its further recapturing into the stable phase oscillation mode at 33.3 MHz is carried out. The peculiarities of the RF system designed for these purposes with an account of the strong beam loading are discussed. The cavities main characteristics have been calculated. 9 refs.; 10 figs.

24315 (INIS-RU–343, pp. 54-57) **On construction of numerical methods in problems of beam control.** Ovsyannikov, D.A. (Leningradskij Gosudarstvennyj Univ., Leningrad (Russian Federation)); Kharchenko, A.G.; Papkovich, V.G. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (Russian Federation). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i; AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1991. [80p.] (In Russian). In *Nuclear-physical researches (Theory and experiment): Scientific-technical collection.* Order Number DE93626131. Source: OSTI; NTIS (US Sales Only); INIS.

Construction of new numerical optimization methods in problems of charged particle beam control is presented on the basis of the analysis of phase-controlled region boundary dynamics. Such being the case, the number of computations is decreased significantly. 3 refs.; 1 tab.

24316 (INIS-RU–343, pp. 49-53) **Analysis of transverse instability on a chain of resonators accounting for bunch trajectory disturbance.** Bulyak, E.V. (AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst.); Mondrus, I.N. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (Russian Federation). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i; AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1991. [80p.] (In Russian). In *Nuclear-physical researches (Theory and experiment): Scientific-technical collection.* Order Number DE93626131. Source: OSTI; NTIS (US Sales Only); INIS.

Theoretical consideration of the development dynamics of transverse instability in a chain of uncoupled cylindric resonators takes into account the excitation of bunch trajectory inside the resonator by difocusing oscillation field. A generalized transverse instability equation is derived and integral representation of its solution is found. The analysis of this solution forms the basis for formulation of 'thin lens' approximation applicability conditions when bunch trajectory excitation is not accounted for. The reliability of these conditions is confirmed through comparison of asymptotic theory results and numeric simulation of transverse instability. 8 refs.; 4 figs.; 1 tab.

24317 (INIS-RU–343, pp. 45-48) **Transverse dynamics of a beam in a chain of uncoupled resonators.** Bulyak, E.V. (AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst.); Kurilko, V.I.; Mondrus, I.N.; Papkovich, V.G. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (Russian Federation). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i; AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1991. [80p.] (In Russian). In *Nuclear-physical researches (Theory and experiment): Scientific-technical collection.* Order Number DE93626131. Source: OSTI; NTIS (US Sales Only); INIS.

A method is proposed and realized for full-scale numerical simulation of the transverse dynamics of a train of point charged bunches accelerated in a chain of identical uncoupled resonators. Selfconsistent system of equations of transverse motion of such bunches in a total field of spontaneous transition radiation of the predecessors of each bunch at f_{11} frequency of defocusing TM_{110}-oscillations of the resonators is reduced to the system of the finite number of algebraic equations for amplitudes of generalized shift moments of such bunches in each resonator. Numerical solutions of this system are presented for a number of specific values of the parameters of the accelerating structure and accelerating beam as well as various starting conditions at the structure's inlet. The obtained results are used for controlling reliability level of the known methods of analytical description of the dynamics under consideration. 6 refs.; 3 figs.

24318 (INIS-RU–343, pp. 40-42) **EH_{11} wave reflection effecting on the dynamics of beam transverse instability in an electron linac.** Ajzatskij, N.I. (AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst.); Opanasenko, A.N. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (Russian Federation). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i; AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1991. [80p.] (In Russian). In *Nuclear-physical researches (Theory and experiment): Scientific-technical collection.* Order Number DE93626131. Source: OSTI; NTIS (US Sales Only); INIS.

Critical current dependences on decelerating structure parameters and coefficient of EH_{11} wave reflection from structure's flanges are derived. It is shown that for structures with positive EH_{11} wave dispersion, critical reflection current increases by several orders of magnitude as reflection coefficient decreases; it points to a possibility to use these structures in high-current electron linacs. As regards suppression of transverse instability, two methods of measuring EH_{11} wave dispersion in an ring diaphragmatic waveguide are analyzed: through increase of a/λ load factor and by making thin radial cuts on the diaphragms. 11 refs.; 3 figs.

24319 (INIS-RU–343, pp. 27-29) **System for measuring accelerated particle bunch charge.** Rozenblat, A.M. (Moskovskij Inzhenerno-Fizicheskij Inst., Moscow (Russian Federation)). Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (Russian Federation). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i; AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1991. [80p.] (In Russian). In *Nuclear-physical researches (Theory and experiment): Scientific-technical collection.* Order Number DE93626131. Source: OSTI; NTIS (US Sales Only); INIS.

A system for measuring individual bunches of accelerated particle pulsed beams is described; the system uses a Faraday cup as the primary charge converter. The operation of the system is based on conversion of bunch charge value in a pulse duraction. At the first stage of operation, bunch charge is partially redistributed between the Faraday cup and buffer integrator. At the second stage, this charge is compensated by known and stable current with parallel resolution of time interval within which complete compensation occurrs. 3 refs.; 2 figs.

24320 (INIS-RU–343, pp. 61-65) **Effect of beam holes on collective transition radiation.** Vorogushin, M.F. (Nauchno-Issledovatel'skij Inst. Ehlektrofizicheskoj Apparatury, Leningrad (Russian Federation)); Chernogubovskij, M.A. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (Russian Federation). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i; AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1991. [80p.] (In Russian). In *Nuclear-physical researches (Theory and experiment): Scientific-technical collection.* Order Number DE93626131. Source: OSTI; NTIS (US Sales Only); INIS.

Beam-excited hole diffraction field is considered through determination of additional magnetic shield field. The method of delayed potentials and mirror reflections is used. Hole diffraction field is found and that allows to take into account its effect on the particle dynamics in accelerating structures and beam transport devices. Radiation energy in hole field is determined; it is ascertained that the presence of beam holes results in a decrease of energy losses for collective transition radiation in the resonator. 6 refs.; 2 figs.

24321 (INIS-RU–343, pp. 66-70) **Transition radiation in a waveguide during sequence intersection by a charged particle of waveguide walls.** Barsukov, K.A. (Erevanskij Fizicheskij Inst., Erevan (Armenia)); Begloyan, Eh.A.; Laziev, Eh.M.; Marabyan, R.I. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (Russian Federation). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i; AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1991. [80p.] (In Russian). In *Nuclear-physical researches (Theory and experiment): Scientific-technical collection.* Order Number DE93626131. Source: OSTI; NTIS (US Sales Only); INIS.

Radiation of a charged particle intersecting a rectangular waveguide along periodic trajectory is studied. Expressions for radiation fields and energies are derived. When the number of intersections is high, radiation spectrum is quasidiscrete and intensity of individual lines depends on the parameters of the problem. Possibility of optimal take off of radiation energy is investigated. 4 refs.; 1 fig.

24322 (JINR–9-90-485) **Computerized simulation of a correction for the nuclotron closed orbit.** Akishin, P.G. (and others); Dinev, D.Kh.; Issinskij, I.B. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of High Energy. 1990. [15p.] (In Russian). Order Number DE93626150. Source: OSTI; NTIS (US Sales Only); INIS.

Four different methods for closed orbit correction in synchrotrons and results of the computerized simulations of the closed orbit correction for the JINR nuclotron are presented. For the irregular arrangement of the 20 corrector magnets and 24 beam position monitors the dynamic and LSQ correction methods have turned out the most effective one. The LSQ method allowed to reach 3.6 and 4.0 correction quality for horizontal and vertical planes respectively. 9 refs.; 4 figs.; 2 tabs.

24323 (JINR-E–9-91-382) **The ion cooling in EBIS.** Becker, R.; Donets, E.D.; Shirkov, G.D. Joint Inst. for Nuclear Research, Dubna (Russian Federation). 1991. [7p.] Order Number DE93626148. Source: OSTI; NTIS (US Sales Only); INIS.

The article is devoted to the problems of multicharged ion losses and ion cooling in EBIS. The loss rates for ions with Boltzmann distribution function of energies for different ionic species are determined. The results of the work have shown that the lightest ions are required for ion cooling. The continuous flow of light ions is proposed for cooling. The necessary parameters of light ion flow are defined. 8 refs.; 1 fig.; 1 tab.

24324 (JINR-R–9-92-129) **Algorithm of synthesis and analysis of magnetic structure characteristics of isochronous cyclotrons with cylindrical poles.** Gul'bekyan, G.G.; Franko, J. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of Nuclear Reactions. 1992. [16p.] (In Russian). Order Number DE93626149. Source: OSTI; NTIS (US Sales Only); INIS.

The analysis of some magnetic structure dependencies of the compact cyclotron magnets with cylindrical poles made of magnetic iron with carbon content from 0.03 up to 0.07% is carried out. 8 refs.; 13 figs.

24325 (LA-UR–93-1961) **Advanced computers and simulation.** Ryne, R.D. Los Alamos National Lab., NM (United States). [1993]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930511–78: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93014354. Source: OSTI; NTIS; INIS; GPO Dep.

Accelerator physicists today have access to computers that are far more powerful than those available just 10 years ago. In the early 1980's, desktop workstations performed less one million floating point operations per second (Mflops), and the realized performance of vector supercomputers was at best a few hundred Mflops. Today vector processing is available on the desktop, providing researchers with performance approaching 100 Mflops at a price that is measured in thousands of dollars. Furthermore, advances in Massively Parallel Processors (MPP) have made performance of over 10 gigaflops a reality, and around mid-decade MPPs are expected to be capable of teraflops performance. Along with advances in MPP hardware, researchers have also made significant progress in developing algorithms and software for MPPS. These changes have had, and will continue to have, a significant impact on the work of computational accelerator physicists. Now, instead of running particle simulations with just a few thousand particles, we can perform desktop simulations with tens of thousands of simulation particles, and calculations with well over 1 million particles are being performed on MPPs. In the area of computational electromagnetics, simulations that used to be performed only on vector supercomputers now run in several hours on

desktop workstations, and researchers are hoping to perform simulations with over one billion mesh points on future MPPs. In this paper we will discuss the latest advances, and what can be expected in the near future, in hardware, software and applications codes for advanced simulation of particle accelerators.

24326 (SLAC-PUB–6163) **Full-turn symplectic map from a generator in a Fourier-spline basis.** Berg, J.S. (Stanford Linear Accelerator Center, Menlo Park, CA (United States)); Warnock, R.L.; Ruth, R.D.; Forest, E. Stanford Linear Accelerator Center, Menlo Park, CA (United States). Apr 1993. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00515 ;AC03-76SF00098. (LBL–34036;CONF-930269–13: Computational accelerator physics conference (CAP93), Pleasanton, CA (United States), 22-26 Feb 1993). Order Number DE93013107. Source: OSTI; NTIS; INIS; GPO Dep.

Given an arbitrary symplectic tracking code, one can construct a full-turn symplectic map that approximates the result of the code to high accuracy. The map is defined implicitly by a mixed-variable generating function. The implicit definition is no great drawback in practice, thanks to an efficient use of Newton's method to solve for the explicit map at each iteration. The generator is represented by a Fourier series in angle variables, with coefficients given as B-spline functions of action variables. It is constructed by using results of single-turn tracking from many initial conditions. The method has been appliedto a realistic model of the SSC in three degrees of freedom. Orbits can be mapped symplectically for 10^7 turns on an IBM RS6000 model 320 workstation, in a run of about one day.

24327 (SSCL–606) **Longitudinal head-tail instability in a non-harmonic potential well.** Chen, B.; Chao, A. Superconducting Super Collider Lab., Dallas, TX (United States). Apr 1993. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. Order Number DE93013942. Source: OSTI; NTIS; INIS; GPO Dep.

A perturbation technique is developed that can be applied to study the collective instability problem when the unperturbed system is not described by a simple harmonic oscillator. The Longitudinal Head-Tail instability effect is well studied as applications of this technique. Applications of the longitudinal head-tail instability effects to the CERN SPS and the SSC are included.

24328 (SSCL–618) **ZBEAM, charge tracing code for the SSC environment.** Tsyganov, E. (Superconducting Super Collider Lab., Dallas, TX (United States)); Zinchenko, A. Superconducting Super Collider Lab., Dallas, TX (United States). Mar 1993. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. Order Number DE93013945. Source: OSTI; NTIS; INIS; GPO Dep.

A full Monte Carlo computer code describing behavior of electrons and ions in the vicinity of any space charges, electrical fields, and magnetic fields is described. Parameters of the code are optimized for the Superconducting Super Collider environment. Some results of calculations with a neutral beam profile monitor, a residual gas beam profile monitor, and an electron beam emittance monitor are presented to illustrate the method.

24329 (SSCL-Preprint–149-Rev.1) **A parallel implementation of particle tracking with space charge effects on an Intel iPSC/860: Revision 1.** Chang, L.C.; Bourianoff, G.; Cole, B.; Machida, S. Superconducting Super Collider Lab., Dallas, TX (United States). Apr 1993. 24p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-930537–8-Rev.1: 5. annual international industrial symposium on the super collider and exhibition, San Francisco, CA (United States), 6-8 May 1993). Order Number DE93012307. Source: OSTI; NTIS; INIS; GPO Dep.

Particle-tracking simulation is one of the scientific applications that is well-suited to parallel computations. At the Superconducting Super Collider, it has been theoretically and empirically demonstrated that particle tracking on a designed lattice can achieve very high parallel efficiency on a MIMD Intel iPSC/860 macene. The key to such success is the realization that the particles can be tracked independently without considering their interaction. The perfectly parallel nature of particle tracking is broken if the interaction effects between particles are included. The space charge introduces an electromagnetic force that will affect the motion of tracked particles in 3-D space. For accurate modeling of the beam dynamics with space charge effects, one needs to solve three-dimensional Maxwell field equations, usually by a particle-in-cell (PIC) algorithm. This will require each particle to communicate with its neighbor grids to compute the momentum changes at each time step. It is expected that the 3-D PIC method will degrade parallel computer. In this paper, we describe an efficient scheme for implementing particle tracking with space charge effects on an INTEL iPSC/860 machine. Experimental results show that a parallel efficiency of 75% can be obtained.

24330 (SSCL-Preprint–220) **DILUTE: A code for studying beam evolution under rf noise.** Shih, H.J. (Superconducting Super Collider Lab., Dallas, TX (United States)); Ellison, J.; Schiesser, W. Superconducting Super Collider Lab., Dallas, TX (United States). Apr 1993. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-930269–12: Computational accelerator physics conference (CAP93), Pleasanton, CA (United States), 22-26 Feb 1993). Order Number DE93011605. Source: OSTI; NTIS; INIS; GPO Dep.

Longitudinal beam dynamics under rf noise has been modeled by Dome, Krinsky and Wang using a diffusion-inaction PDE. If the primary interest is the evolution of the beam in action, it is much simpler to integrate the model PDE than to undertake tracking simulations. Here we describe the code that we developed to solve the model PDE using the numerical Method of Lines. Features of the code include (1) computation of the distribution in action for the initial beam from a Gaussian or user-supplied distribution in longitudinal phase space, (2) computation of the diffusion coefficient for white noise or from a user-supplied spectral density for non-white noise, (3) discretization of the model PDE using finite-difference or Galerkin finite-element approximations with a uniform or non-uniform grid, and (4) integration of the system of ODEs in time by the solver RKF45 or a user-supplied ODE solver.

24331 (SSCL-Preprint–299) **Tune shift effect due to the sextupole longitudinal periodic structure in the superconducting dipole magnets.** Lopez, G.; Chen, S. Superconducting Super Collider Lab., Dallas, TX (United States). May 1993. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-930511–36: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93014256. Source: OSTI; NTIS; INIS; GPO Dep.

Using the standard Hamiltonian perturbation theory, the tune shift due to the sextupole periodic pattern in the superconducting dipole magnets is estimated for the Superconducting Super Collider (SSC) machine. The result indicates that this effect is of the order of 10^{-9}. Therefore, this effect can be neglected in the dynamics of the beam.

24332 (SSCL-Preprint–304) **Head-on and long-range beam-beam tune shift spread in the SSC.** Lopez, G. Superconducting Super Collider Lab., Dallas, TX (United States). May 1993. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-930511–24: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93014259. Source: OSTI; NTIS; INIS; GPO Dep.

The head-on and long-range incoherent tune shifts for the Superconducting Super Collider (SSC) are estimated using the numerical integration of the analytical expression coming from the first order in the perturbation strength. The variation of the tune shift as a function of the displacements of the charged particle in the vertical and horizontal planes is studied with the nominal parameters for the SSC. A scaling expression is obtained for the parameters involved in the beam-beam tune shifts, which allows us to predict the effect in the incoherent tune shift spread under changes in these parameters.

24333 (SSCL-Preprint–351) **Beam coupling impedance measurements and simulations of a beam pipe liner with pumping holes or slots.** Ruiz, E.; Walling, L.; Goren, Y.; Spayd, N. Superconducting Super Collider Lab., Dallas, TX (United States). May 1993. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-930511–18: International particle accelerator conference, Washington, DC

(United States), 17-20 May 1993). Order Number DE93014270. Source: OSTI; NTIS; INIS; GPO Dep.

We report the results of measurement using the wire method and numerical simulations using the code HFSS (High-Frequency Structure Simulator) of the beam coupling impedance of the proposed liner for the collider ring of the SSC. We compare the results of the measurements and simulations to analytical estimates by R. Gluckstern and S. Kurennoy, and conclude that the additional coupling impedance introduced by a liner with pumping holes can be acceptable.

24334 (SSCL-Preprint–355) **Non linear effects in ferrite tuned cavities.** Goren, Y. (Superconducting Super Collider Lab., Dallas, TX (United States)); Mahale, N.; Walling, L.; Enegren, T.; Hulsey, G.; Yakoviev, V.; Petrov, V. Superconducting Super Collider Lab., Dallas, TX (United States). May 1993. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-930511–34: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93014136. Source: OSTI; NTIS; INIS; GPO Dep.

The phenomenon of dependence of the resonance shape and frequency on the RF power level in perpendicular biased ferrite-tuned cavities has been observed by G. Hulsey and C. Friedrichs in the SSC test cavity experiment. This paper presents a theoretical as well as numerical analysis of this phenomenon and compares the results with experimental data. The effect of this nonlinearity on the SSC low energy booster prototype cavity is discussed.

24335 (SSCL-Preprint–365) **Emittance growth in MEB and its control.** Huang, Y.; Machida, S.; Gerig, R. Superconducting Super Collider Lab., Dallas, TX (United States). May 1993. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-930511–26: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93014265. Source: OSTI; NTIS; INIS; GPO Dep.

There are effects in the Medium Energy Booster (MEB) of the Superconducting Super Collider (SSC) which will lead to growth of the transverse beam emittance. Among them are space charge, decoherence due to residual chromaticity and nonlinearity of field, coherent instabilities, etc. This paper numerically estimates the strength of these effects on the beam stability and the emittance growth. To ensure that the emittance growth is within the stringent emittance budget of the SSC accelerator complex, a few feasible cures have been planned. Their improvements on beam quality are also described in this paper.

24336 (SSCL-Preprint–382) **Bunch coalescing studies for the SSC.** Mahale, N.; Yan, Y.T.; Ellison, J. Superconducting Super Collider Lab., Dallas, TX (United States). May 1993. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-930511–13: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93014106. Source: OSTI; NTIS; INIS; GPO Dep.

It may become necessary to enhance the luminosity and increase the bunch spacing in the Superconducting Super Collider (SSC). Here we study the feasibility of bunch coalescing to achieve this. We choose the Medium Energy Booster (MEB) at extraction, momentum 200GeV, to perform the operation. In order to properly align the bunches we propose to linearize the RF using the second and third harmonics. Theoretical studies with simulation are presented. The program ESME is used for the simulation.

24337 (SSCL-Preprint–386) **Dynamic aperture of the chromatically corrected Collider lattice.** Pilat, F.; Nosochkov, Y.; Sen, T.; Stiening, R. Superconducting Super Collider Lab., Dallas, TX (United States). May 1993. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-930511–88: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93014099. Source: OSTI; NTIS; INIS; GPO Dep.

A scheme for correcting the second order chromatic effects generated by the Interaction Regions (IRS) has been designed for the SSC Collider ring, where four families of sextupoles are located in the arc sectors next to the East Cluster. The effect of these sextupoles on the dynamic and momentum aperture of the machine has been evaluated with a simulation model in which alignment, field errors and operational corrections are realistically represented. Several optics configurations with different values of β at the Interaction Points (IPs) have been studied for different sets of field error specifications in the IR quadrupoles. The local chromaticity correction system improves the momentum aperture of the Collider for every configuration studied with no relevant loss of dynamic aperture on momentum, when the effect of errors are taken into consideration.

4303 Auxiliaries and Components

Refer also to citation(s) 24088, 24262, 24304, 24328, 24331, 24334, 24335, 24435, 24437, 24438, 24450, 24451, 24462, 24480, 25048

24338 (ANL/APS/TB–12) **The insertion device magnetic measurement facility: Prototype and operational procedures.** Burkel, L. (Argonne National Lab., IL (United States). Advanced Photon Source Accelerator Systems Div.); Dejus, R.; Maines, J.; O'Brien, J.; Vasserman, I.; Pfleuger, J. Argonne National Lab., IL (United States). Advanced Photon Source Accelerator Systems Div. Mar 1993. 55p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. Order Number DE93012298. Source: OSTI; NTIS; INIS; GPO Dep.

This report is a description of the current status of the magnetic measurement facility and is a basic instructional manual for the operation of the facility and its components. Please refer to the appendices for more detailed information about specific components and procedures. The purpose of the magnetic measurement facility is to take accurate measurements of the magnetic field in the gay of the IDs in order to determine the effect of the ID on the stored particle beam and the emitted radiation. The facility will also play an important role when evaluating new ideas, novel devices, and inhouse prototypes as part of the ongoing research and development program at the APS. The measurements will be performed with both moving search coils and moving Hall probes. The IDs will be evaluated by computer modeling of the emitted radiation for any given (measured) magnetic field map. The quality of the magnetic field will be described in terms of integrated multipoles for the effect on Storage Ring performance and in terms of the derived trajectories for the emitted radiation. Before being installed on the Storage Ring, every device will be measured and characterized to assure that it is compatible with Storage Ring requirements and radiation specifications. The accuracy that the APS needs to achieve for magnetic measurements will be based on these specifications.

24339 (ANL/ASD/RP–79396) **Fundamental mode rf power dissipated in a waveguide attached to an accelerating cavity.** Kang, Y.W. Argonne National Lab., IL (United States). 9 Feb 1993. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. Order Number DE93011758. Source: OSTI; NTIS; INIS; GPO Dep.

An accelerating RF cavity usually requires accessory devices such as a tuner, a coupler, and a damper to perform properly. Since a device is attached to the wall of the cavity to have certain electrical coupling of the cavity field through the opening. RF power dissipation is involved. In a high power accelerating cavity, the RF power coupled and dissipated in the opening and in the device must be estimated to design a proper cooling system for the device. The single cell cavities of the APS storage ring will use the same accessories. These cavities are rotationally symmetric and the fields around the equator can be approximated with the fields of the cylindrical pillbox cavity. In the following, the coupled and dissipated fundamental mode RF power in a waveguide attached to a pillbox cavity is discussed. The waveguide configurations are (1) aperture-coupled cylindrical waveguide with matched load termination; (2) short-circuited cylindrical waveguide; and (3) E-probe or H-loop coupled coaxial waveguide. A short-circuited, one-wavelength coaxial structure is considered for the fundamental frequency rejection circuit of an H-loop damper.

24340 (ANL-HEP-TR–92-129) **Database computing in HEP: Progress report.** Day, C.T. (Lawrence Berkeley Lab., CA (United States)); Loken, S.; MacFarlane, J.F.; May, E.; Lifka, D.; Lusk, E.;

Price, L.E.; Baden, A.; Grossman, R.; Qin, X.; Cormell, L.; Leibold, P.; Liu, D.; Nixdorf, U.; Scipioni, B. Argonne National Lab., IL (United States). [1992]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. Order Number DE93011765. Source: OSTI; NTIS; INIS; GPO Dep.

The major SSC experiments are expected to produce up to 1 Petabyte of data per year each. Once the primary reconstruction is completed by farms of inexpensive processors. I/O becomes a major factor in further analysis of the data. We believe that the application of database techniques can significantly reduce the I/O performed in these analyses. We present examples of such I/O reductions in prototype based on relational and object-oriented databases of CDF data samples.

24341 (BNL–47434) **Time-dependent hydrogen and helium pressure profiles in a long, cryogenically cooled tube, pumped at periodic intervals.** Hobson, J.P. (National Vacuum Technologies, Inc., Ontario (Canada)); Welch, K.M. Brookhaven National Lab., Upton, NY (United States). [1992]. 23p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-921129–8: 39. national symposium of the American Vacuum Society, Chicago, IL (United States), 9-13 Nov 1992). Order Number DE93013340. Source: OSTI; NTIS; INIS; GPO Dep.

Many particle accelerators and colliders throughout the world make use of superconducting magnets to focus highly relativistic beams. These magnets are cooled to ~4.2°K For practical reasons, the beam pipes, encircled by the magnets, also operate at these cryogenic temperatures. This paper presents a theoretical model for determining pressure profiles, in space and time, stemming from either hydrogen or helium gas leak into the cold-bore tube with appendage pumps located at periodic intervals. It is shown that a wave-like pressure gradient propagates from the leak source at a rate which is dependent on the leak magnitude, gas species, speed and location of appendage pumps, and the geometry and effective roughness of the cold-bore tube. Steady-state, linear pressure gradients eventually equilibrate between the appendage pumps in a magnitude commensurate with both the adsorption isotherm of the species and mass flow in the beam pipe. Results are given for a variety of conditions relevant to the Relativistic Heavy Ion Collider being constructed at Brookhaven, and a general procedure, with expressions, is provided for the making of similar calculations in other installations.

24342 (BNL–47435-Rev.3/93) **The pumping of hydrogen and helium by sputter-ion pumps: Revision 3/93.** Welch, K.M.; Pate, D.J.; Todd, R.J. Brookhaven National Lab., Upton, NY (United States). [1992]. 22p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-921129–9-Rev.3/93: 39. national symposium of the American Vacuum Society, Chicago, IL (United States), 9-13 Nov 1992). Order Number DE93012529. Source: OSTI; NTIS; INIS; GPO Dep.

The pumping of hydrogen in diode and triode sputter-ion pumps is discussed. The type of cathode material used in these pumps is shown to have a significant impact on the effectiveness with which hydrogen is pumped. Examples of this include data for pumps with aluminum and titanium-alloy cathodes. Diode pumps with aluminum cathodes are shown to be no more effective in the pumping of hydrogen than in the pumping of helium. The use of titanium or titanium alloy anodes is also shown to measurably impact on the speed of these pumps at.very low pressures. This stems from the fact that hydrogen is $\times 10^6$ more soluble in titanium than in stainless steel. Hydrogen becomes resident in the anodes because of fast neutral burial. Lastly, quantitative data are given for the He speeds and capacities of both noble and conventional diode and triode pumps. The effectiveness of various pump regeneration procedures, subsequent to the pumping of He, is reported.These included bakeout and N_2 glow discharge cleaning. The comparative desorption of He with the subsequent pumping of N_2 is reported on. The N_2 speed of these pumps was used as the benchmark for defining the size of the pumps vs. their respective He speeds.

24343 (BNL–48230) **The AGS-Booster complex for the g-2 experiment and RHIC injection.** Tanaka, Mitsuyoshi; Lee, Yong Y. Brookhaven National Lab., Upton, NY (United States). [1993]. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-930511–123: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93014305. Source: OSTI; NTIS; INIS; GPO Dep.

The delivery of a beam with characteristics appropriate for the g-2 muon storage ring and the filling of the RHIC heavy ion collider from the AGS main ring requires a new fast extracted beam (NewFEB) system. The NewFEB system must be capable of performing single bunch multiple extraction of a heavy ion beam, as well as a high intensity proton beam at a time interval of 25 ms up to 12 times per AGS cycle. The new system will consist of a fast multipulsing kicker and an ejector septum magnet with local orbit bumps.

24344 (BNL–70202) **[Electron accelerator and collider research]: Foreign trip report, July 18, 1992–August 2, 1992.** Fischer, J. Brookhaven National Lab., Upton, NY (United States). 1 Sep 1992. 102p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. Order Number DE93012144. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Impressions of laser-driven photocathode R&D and RF e^- guns at the LAL. Discussions of photoelectron energy analysis and of some facilities at the CEN Saclay Laser Interaction Lab. Photoemission in theory and practice, including ion implantation of cathodes at the University of Claude Bernard in Lyon. Photocathode R&D and CLIC facility at CERN. Selected impressions and progress reported at the e^+-e^- Collider Workshop in Garmisch, Germany. Copy of transparencies of some presentations are included.

24345 (CONF-9206193–25) **Experimental gyroklystron research at the University of Maryland for application to TeV linear colliders.** Lawson, W.; Granatstein, V.L.; Hogan, B.; Koc, U.V.; Latham, P.E.; Main, W.; Matthews, H.W.; Nusinovich, G.S.; Reiser, M.; Striffler, C.D.; Tantawi, S. Maryland Univ., College Park, MD (United States). [1992]. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG05-91ER40642. From Advanced accelerator concepts workshop; Port Jefferson, NY (United States); 14-20 Jun 1992. Order Number DE93010174. Source: OSTI; NTIS; INIS; GPO Dep.

X-Band and K-Band gyroklystrons are being evaluated for possible application to future linear colliders. So far we have examined the different two- and three-cavity configurations. We have achieved a maximum peak power of 27 MW in ~1 μs pulses at a gain of 36 dB and an efficiency exceeding 32%. The nominal parameters include a 430 kV. 150–200 A beam with an average perpendicular to parallel velocity ratio near one. In this paper, we detail our progress to date and describe our plans for future experiments that should culminate in amplifier outputs in excess of 100 MW in 1 μs pulses.

24346 (DOE/FTR–93011935) **[Travel to the Heavy Ion Research Center and the Nuclear Research Center, Germany and the conference on physics of high energy density in matter, Austria]: Foreign trip report, January 24, 1993–February 7, 1993.** Mehlhorn, T.A.; Slutz, S.A. Sandia National Labs., Albuquerque, NM (United States). 18 Mar 1993. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. Order Number DE93011935. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The trip was from January 24 to February 7, 1993. The primary purpose was to present at the Hirschegg Conference the invited papers "Target experiments at the petawatt/g level at Sandia National Laboratories" by T. Mehlhorn and "Theory of high current density multistage acceleration" by S. Slutz. The intense ion beams and the interaction of such ion beams with matter. A synopsis of each visit is included.

24347 (FNAL/C–92-239) **Magnetic field properties of SSC model dipole magnets.** Wake, M. (Fermi National Accelerator Lab., Batavia, IL (United States)); Bossert, R.; Carson, J.; Delchamps, S.; Jaffery, T.S.; Kinney, W.; Koska, W.; Lamm, M.J.; Strait, J.; Butteris, J.; Sims, R.; Winters, M. Fermi National Accelerator Lab., Batavia, IL (United States). Sep 1992. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03000. (CONF-920315–46: 3. European particle accelerator conference (EPAC-3): Accelerators for special applications, Berlin

(Germany), 24-28 Mar 1992). Order Number DE93013567. Source: OSTI; NTIS; INIS; GPO Dep.

SSC 1.5m model dipole magnets were built and tested at Fermilab. Magnetic field properties were studied in term of transfer function variation and multipole components. The results were satisfactory. Observation of periodicity of remanent field along the axis is also reported.

24348 (FNAL/C–92/308) **The Dv software trigger.** Linnemann, J.T. (Fermi National Accelerator Lab., Batavia, IL (United States)). For the DO Collaboration. Fermi National Accelerator Lab., Batavia, IL (United States). Oct 1992. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03000. (CONF-920966–26: 10. conference on computing in high energy physics, Annecy (France), 21-25 Sep 1992). Order Number DE93014030. Source: OSTI; NTIS; INIS; GPO Dep.

In the Dv experiment, the software filter operates in a processor farm with each node processing a single event. Processing is data-driven: the filter does local processing to verify the candidates from the hardware trigger. The filter code consists of independent pieces called "tools"; processing for a given hardware bit is a "script" invoking one or more "tools" sequentially. An offline simulator drives the same code with the same configuration files, running on real or simulated data. Online tests use farm nodes parasiting on the data stream. We discuss the performance of the system and how we attempt to verify its correctness.

24349 (IFVE-OLU–90-131) **Work on RF superconducting cavities done at Institute for High Energy Physics: 1. Experimental technological equipment.** Sevryukova, L.M. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov (Russian Federation). Inst. Fiziki Vysokikh Ehnergij. 1990. [25p.] (In Russian). Order Number DE93626165. Source: OSTI; NTIS (US Sales Only); INIS.

The paper describes the complex of experimental technological equipment exploited for the manufacturing, treatment and study of superconducting cavities. The complex incorporates the necessary technological, measuring and cryogenic equipment enabling one to manufacture copper superconducting cavities without welding seams with further applying superconducting films onto their working surfaces. 14 refs.; 23 figs.

24350 (IHEP-OEF–90-81) **Experiments on hyperon beam of UNK.** Garkusha, V.I. (and others); Golovkin, S.V.; Gorin, A.M. Collaboration. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov (Russian Federation). Inst. Fiziki Vysokikh Ehnergij. 1990. [87p.] (IFVE-OEF–90-81.). Order Number DE93626176. Source: OSTI; NTIS (US Sales Only); INIS.

The experimental program for the UNK hyperon beams is considered. It is expected, that a focused pure Σ^-hyperon beam with P$\simeq$2700 GeV/c, intensity $>10^7$ Σ^-/s and >85% of Σ^- hyperons may be created in this machine. The magnetized iron shielding will allow one to reduce the muon halo by 2 orders of magnitude. The experiments on the study of strange-charmed and strange-beauty baryons, search for exotic states with strangeness and charm and cryptoexotic strange hadrons with hidden charm and beauty are discussed. The possibilities of the hyperon beam for these processes are unique. Future studies of hyperon form-factors and structure functions of the processes in the nuclear Coulomb field, rare decays of charmed and beauty particles, τ-leptons and hyperons are also considered. 42 refs.; 28 figs.; 17 tabs.

24351 (INIS-RU–343, pp. 19-22) **Ion injector beam potential.** Demchenko, P.A. (AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst.); Yashin, P.V. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (Russian Federation). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i; AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1991. [80p.] (In Russian). In *Nuclear-physical researches (Theory and experiment): Scientific-technical collection.* Order Number DE93626131. Source: OSTI; NTIS (US Sales Only); INIS.

The article presents the description of equipment and results of measuring the potential of space charge of proton beams produced in a high-current pulse injector of linear accelerator. Ion beam energy was 100 keV, current - about 50 mA at 1 ms duration. Potential measurements are based on the method of thermal probe and analysis of energy spectra of residual gas ions generated in collisions with beam particles. It is ascertained that under certain boundary conditions space beam charge in drift space is compensated to a significant extent with residual gas ionization electrons, the value of their potential is in agreement with applicable theoretical models. Electron purification of beams with external electrode electric fields results in a growth of the potential up to expected vacuum values. Such being the case, their divergence and dimensions are increasing under impact of space charge field resulting in a specific evolution of cross sections of beam phase space. 7 refs.; 4 figs.

24352 (INIS-RU–343, pp. 37-39) **Maximum water purity in cooling systems of electrophysical equipment.** Zarubin, B.T. (AN SSSR, Moscow (Russian Federation). Radiotekhnicheskij Inst.); Kamalov, K.K.; Mishchenko, A.V.; Obraztsov, A.A.; Pirozhenko, V.M.; Khudyashova, G.B.; Tsunikova, E.I.; Shashkova, V.D. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (Russian Federation). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i; AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1991. [80p.] (In Russian). In *Nuclear-physical researches (Theory and experiment): Scientific-technical collection.* Order Number DE93626131. Source: OSTI; NTIS (US Sales Only); INIS.

Missing values of the rates of highly demineralized water contamination with copper and stainless steel are determined experimentally; these values are required for calculating cooling systems of electrophysical equipment. Usefulness of the data and calculation formulae used have been proved experimentally at the 200 kW operating high-frequency channel and copper cavity of linear proton accelerator. 4 refs.

24353 (INIS-RU–343, pp. 43-44) **Calculation of characteristics of diaphragmatic waveguide with different period.** Ajzatskij, N.I. (AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst.); Volobuev, V.V. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (Russian Federation). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i; AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1991. [80p.] (In Russian). In *Nuclear-physical researches (Theory and experiment): Scientific-technical collection.* Order Number DE93626131. Source: OSTI; NTIS (US Sales Only); INIS.

Within the scope of the project of a high current ($\approx$50 A) short-pulse ($\approx$10 ns) electron accelerator development in the Kharkov Physics and Engineering Institute, it was proposed to use a ring diaphragmatic waveguide as the accelerating section; transition to the acceleration of the reverse wave, whose phase velocity is equal to light velocity, by the first space harmonic has been accomplished by increasing space period of the structure in the waveguide. Calculations of waveguide electrodynamic characteristics depending on structure's period value were performed to establish application capabilities of such waveguides. The calculation results show that transition to the sections with accelerating wave phase carry over in the period lying in π-2π interval allows to increase the accelerated beam charge. 4 refs.; 2 tabs.

24354 (INIS-RU–343, pp. 32-34) **Production of polarized electron beam from dielectrics surface.** Efimov, V.P. (AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst.); Zakutin, V.V.; Shenderovich, A.M. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (Russian Federation). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i; AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1991. [80p.] (In Russian). In *Nuclear-physical researches (Theory and experiment): Scientific-technical collection.* Order Number DE93626131. Source: OSTI; NTIS (US Sales Only); INIS.

A method is proposed for producing polarized electron beams through accumulation of nonpolarized electrons on the surface of dielectric, relaxation of their spins in a magnetic field and subsequent detachment of polarized electrons from the surface by the electric field. The proposed method can be implemented even at

room temperatures. For this purpose, electrons shall accumulate on the surface of ferrodielectric with cubic crystalline lattice. In this case an electron beam can be produced with pulse current of ≃100 mA and polarization degree of about 80%. 3 refs.; 2 figs.

24355 (INIS-RU–343, pp. 30-31) **Polarized electron beam production for a linear accelerator by the method of electron beam shock ionization of polarized hydrogen.** Efimov, V.P. (AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst.); Zakutin, V.V.; Il'ichev, I.A.; Romas'ko, V.P.; Shenderovich, A.M. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (Russian Federation). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i; AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1991. [80p.] (In Russian). In *Nuclear-physical researches (Theory and experiment): Scientific-technical collection.* Order Number DE93626131. Source: OSTI; NTIS (US Sales Only); INIS.

A method is proposed for producing polarized electron beam. The method consists in transporting ionizing electron beam through hydrogen polarized atom beam in a longitudinal magnetic field and in extracting produced polarized electrons via pulse voltage. Feasibility of the method has been prooved experimentally by ionizing residual gas. 1 ref.; 3 figs.

24356 (INIS-RU–343, pp. 16-18) **Accelerating section for short-pulse operation of a resonance electron linac.** Ajzatskij, N.I. (AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst.); Biller, E.Z.; Volobuev, V.V.; Dovbnya, A.N.; Kurilko, V.I.; Kushnir, V.A.; Makhnenko, L.A.; Mitrochenko, V.V. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (Russian Federation). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i; AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1991. [80p.] (In Russian). In *Nuclear-physical researches (Theory and experiment): Scientific-technical collection.* Order Number DE93626131. Source: OSTI; NTIS (US Sales Only); INIS.

For short-pulse operation of a resonance electron linac, it is proposed to use an accelerating section based on ring diaphragmatic waveguide with a large angle of particle flight ($\Theta \simeq \omega_0 D/c > \pi$). Particle flight angle is increased through sparser disposition of diaphragms. Such being the case, phase velocity of the first harmonic of accelerating field will exceed velocity of light, therefore, HF-energy is supplied to the section through outlet matching device, and electron acceleration is performed by the first space harmonic of on-coming wave. It is shown that $\Theta > \pi$ transition allows to increase an ultimate accelerated charge while decreasing average acceleration rate. The last disadvantage can be compensated through regeneration or HF-pulse compression system. 4 refs.; 2 figs.

24357 (INIS-RU–343, pp. 3-9) **Experimental study on beam parameters of the 60 MeV compact electron accelerator.** Dovbnya, A.N. (AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst.); Kushnir, V.A.; Stepin, D.L.; Tur, Yu.D.; Mitrochenko, V.V.; Chernyshov, V.V.; Zhiglo, V.F.; Kollerov, Eh.P. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (Russian Federation). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i; AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1991. [80p.] (In Russian). In *Nuclear-physical researches (Theory and experiment): Scientific-technical collection.* Order Number DE93626131. Source: OSTI; NTIS (US Sales Only); INIS.

Experimental study results are presented on beam parameters at the outlet of injector system and 60 MeV accelerator whose compactness (4 m total length) is ensured through application of RF-injector and accelerating section with quasiconstant gradient at acceleration rate exceeding 20 MV/m. 9 refs.; 9 figs.; 2 tabs.

24358 (INIS-RU–343, pp. 58-60) **Spectrum of a circular resonator with diffraction grating loading.** Bulyak, E.V. (AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst.); Kurilko, V.I.; Opanasenko, A.N. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (Russian Federation). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i; AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1991. [80p.] (In Russian). In *Nuclear-physical researches (Theory and experiment): Scientific-technical collection.* Order Number DE93626131. Source: OSTI; NTIS (US Sales Only); INIS.

A theory of axially homogeneous oscillations of a ring resonator with conducting walls is resolved; the resonator is loaded with infinitely thin cylindric diffraction grating which is coaxial to the enclosure. The problems of finding the spectra of accelerating (p=0) and defocusing (p=±1) types of TM_{pqo} oscillations of the resonator is reduced by the method of Agranovich-Marchenko-Shestopalov to the solution of infinite systems of homogeneous algebraic equations with rapidly decreasing coefficients. 1 ref.

24359 (INIS-RU–343, pp. 23-26) **Application of H(2s) atom photoionization electrons for measuring energy of H^- ion beam.** Artemov, A.S. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Sukhumi (Russian Federation). Fiziko-Tekhnicheskij Inst.). Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (Russian Federation). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i; AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1991. [80p.] (In Russian). In *Nuclear-physical researches (Theory and experiment): Scientific-technical collection.* Order Number DE93626131. Source: OSTI; NTIS (US Sales Only); INIS.

A method is proposed for measuring energy spectrum of H^- ion beam at the bending sections of its transport channel; the method relies on utilization of H(2s) stripping atoms and electrons of their photoionization. A compact device is proposed for implementation of the method in the high ion energy region. Basic parameters of the device are calculated for non-exciting control of H^- ion beam energy spectrum at the charge-exchange section of $H^- \rightarrow P$ injection into the proton storage ring of the Moscow meson factory. 14 refs.; 2 figs.

24360 (INIS-RU–343, pp. 35-36) **Protection system of electron linac accelerating structures.** Abrosimov, V.T. (AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst.); Vasil'ev, E.P.; Mufel', V.B.; Tur, Yu.D. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (Russian Federation). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i; AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1991. [80p.] (In Russian). In *Nuclear-physical researches (Theory and experiment): Scientific-technical collection.* Order Number DE93626131. Source: OSTI; NTIS (US Sales Only); INIS.

A system of electron linac accelerating structure protection is described; the system is based on the principle of comparison of SHF enveloping signals at the inlet and outlet of the section. Its efficiency and applicability as an analyzer of optimal conditions of electron beam acceleration are assessed. The check of the protection system shows that high sensitivity of its comparator circuits ensures high efficiency of indication of RF breakdowns and disturbance of beam acceleration conditions in the accelerating structure with high acceleration. 3 refs.; 2 figs.

24361 (JINR–9-90-165) **Programmes for determination of the parameters of the power supply stabilization system on the electronic cyclotron model/EMKC/.** Kalmykov, A.V.; Borisova, M.N. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of Nuclear Problems. 1990. [5p.] (In Russian). Order Number DE93626170. Source: OSTI; NTIS (US Sales Only); INIS.

The paper describes the WES programme which determines the weight of the low-order bit for the current specification channel, taking into account all errors due to elements of the current stabilization system. The programme ZDT is described, it is the core of the programmes used for specifying and measuring current in the coils of the magnet system. 3 refs.; 6 figs.

24362 (JINR-E–1-92-8) **Crystal deflector for relativistic ion colliders.** Kovalenko, A.D.; Taranin, A.M.; Tsyganov, E.N. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of

High Energy. 1992. [11p.] Order Number DE93626162. Source: OSTI; NTIS (US Sales Only); INIS.

Extracted ion beams for fixed target experiments can be provided as a by-product at unique multi-GeV ion colliders by means of bent crystal channeling. The main quaestions in this connection are discussed. Results on efficiency of ion beam deflection and extraction are presented. Calculations on a possible extracted 100-GeV, Au-beam parameters for RHIC were made. 16 refs.; 2 figs.

24363 (JINR-E–9-91-383) **The multiply charged ion production in ECR ion sources.** Shirkov, G. Joint Inst. for Nuclear Research, Dubna (Russian Federation). 1991. [7p.] Order Number DE93626155. Source: OSTI; NTIS (US Sales Only); INIS.

The ion confinement and loss conditions in the open magnetic traps have been analyzed in this article. In EGRIS the ions are confined in the negative potential well. The large output pulse of multiply charged ions in the RF pulse mode is explained. MINI-MAFIOS type EGRIS have been carried out. Some other ways are proposed to obtain the pulse beams of multiply charged ions in EGRIS. 10 refs.; 3 figs.

24364 (JINR-E–9-92-33) **Fundamental processes determining the highly charged ion production in ECR ion sources.** Shirkov, G.D. Joint Inst. for Nuclear Research, Dubna (Russian Federation). 1992. [11p.] Order Number DE93626156. Source: OSTI; NTIS (US Sales Only); INIS.

The ion confinement and loss conditions in the open magnetic traps have been analyzed in this article. In EGRIS the the ions are confined in the negative potential well. The simultaneous application of ion cooling and pulse regime is proposed for pulse injection of highly charged ions in heavy ion accelerators and storage rings. 14 refs.; 3 figs.

24365 (JINR-R–9-91-355) **A cryogenic vacuum pump for the linear accelerator.** Vasilishin, B.V.; Kulikov, I.I.; Pazhentsev, A.N.; Pikin, A.I. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of High Energy. 1991. [4p.] (In Russian). Order Number DE93626168. Source: OSTI; NTIS (US Sales Only); INIS.

The oiless pumping of Linac LU-20 is described. The vacuum pumping is provided with the cryopump that includes a cryopanel that includes a cryopanel inside the radiation shield. Data acquisition and processing system is based on the MERA-60 computer and the electronics of CAMAC ctandard. The cryopump improved vacuum in Linac to $6X10^{-7}$ Torr (the initial vacuum was $2.5X10^{-6}$ Torr). 5 refs.; 1 figs.; 1 tab.

24366 (JINR-R–9-92-14) **Second harmonic phase stabilization system.** Akkuratov, V.A.; Grazov, A.A.; Novikov, D.L. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of Nuclear Problems. 1992. [4p.] (In Russian). Order Number DE93626169. Source: OSTI; NTIS (US Sales Only); INIS.

The circuit units stabilizing the phase of the second harmonic with respect to the first one in the flat-top accelerating regime with a +-0.5 accuracy at the first harmonic frequency 39.609 MHz are presented. These units were used during used during experimental research of the closed orbit expansion effect on the electron model of the ring cyclotron. 4 refs.; 4 figs.

24367 (JINR-R–9-92-37) **The pulse TEA CO_2 laser for a laser ion source.** Kalagin, I.V.; Monchinskij, V.A.; Salimov, Eh.Kh. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of High Energy. 1992. [7p.] (In Russian). Order Number DE93626158. Source: OSTI; NTIS (US Sales Only); INIS.

The detailed description of the pulse TEA CO_2 laser with an ultraviolet preionization of a gas mixture, meaning for a laser ion source is given. The excitement of the laser is carried out by the powerful generator (modulator) with a time compression of an electromagnetic energy by means of using the nonlinear power amplification circuits. The laser has the following performances: the output energy is 13 J per pulse, the half height time of the giant pulse is about 100 ns, the beam divergence is $5X1-^{-3}$ rad, the work frequency up to 1 Hz. 9 refs.; 7 figs.

24368 (JINR-R–13-91-295) **Current transducer for the power supply of the main coil of the iron-current channel at the JINR phasotron.** Batmanova, Eh.K.; Kazakova, G.G.; Kalinichenko, V.V. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of Nuclear Problems. 1991. [6p.] (In Russian). Order Number DE93626166. Source: OSTI; NTIS (US Sales Only); INIS.

A direct current transducer of current rating 12.5 kA is discussed. The conversion error is 10^{-3}. The transducer comprises a cascade first and second measuring direct-current conversion based on magnetic comparison of direct currents. The principle of operation of the transducer is considered, its block-diagram and the block-diagram of the first measuring DC converter are given. The circuit diagram of the magnetic modulation unit of the measuring DC converter is presented. 6 refs.; 3 figs.

24369 (JINR-R–13-91-317) **An ungrounded power supply using superconductors.** Romanov, Yu.I. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of High Energy. 1991. [7p.] (In Russian). Order Number DE93626157. Source: OSTI; NTIS (US Sales Only); INIS.

Basic requirements imposed in the power supplies of fiber optical lines used to operate in control systems of highvoltage electrophysical setups are formulated. Systematization on the existing methods of construction of ungrounded power supplies (UPS) is briefly described. A practical scheme of UPS using suoercondensers is given. Its technical characteristics are presented. 9 refs.; 3 figs.

24370 (JINR-R–13-91-406) **Upgrading of the power supply complex for correcting winding of the U-12CM cyclotron.** Batmanova, Eh.K.; Denisov, Yu.N.; Kazakova, G.G.; Kalinichenko, V.V.; Krzhivanek, M. Joint Inst. for Nuclear Research, Dubna (Russian Federation). 1991. [7p.] (In Russian). Order Number DE93626167. Source: OSTI; NTIS (US Sales Only); INIS.

The complex of power supply units for the correcting windings of the U-12OM cyclotron comprises 20 wide-range direct current stabilizes with current rating 400-600 A. The aim of the upgrading is to increase reliability and to simplify operation, which is achieved by using modern circuitry and new technological solutions. 4 refs.; 4 figs.

24371 (LA-SUB–93-63) **DARHT operations and maintenance manual.** Los Alamos National Lab., NM (United States); Pulse Sciences, Inc., San Leandro, CA (United States). Dec 1991. 72p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. Order Number DE93008819. Source: OSTI; NTIS; GPO Dep.

The Dual Axis Radiographic Hydrodynamic Test (DARHT) injector system was designed, constructed and tested in the dummy load configuration at Pulse Sciences, Inc. (PSI), San Leandro, CA for Los Alamos National Laboratories (LANL) during the period from September 1989 through December 1990. The injector was installed and its operation was demonstrated in the dummy load configuration at LANL from January 1991 through April 1991. Testing of the system configuration into a diode load began in June 1991. Cross-sectional views of the injector in both the dummy load and system configurations are shown. The injector is designed to produce a 4 MV, flat-top (± 1%), 65 nsec (99–99%) acceleration pulse into a 150 ohm load with a command fire jitter of less than 3 nsec (3σ). The load consists of an adjustable sodium thiosulfate solution resistor located at the vacuum tube interface in parallel with an ~1 kΩ electron beam diode. This manual describes the injector and its ancillary systems and gives operating, maintenance and assembly instructions for the system in the dummy load configuration.

24372 (LA-UR–93-1517) **Beam position monitoring in the 100-MHz to 500-MHz frequency range using the log-ratio technique.** Wells, F.D.; Shafer, R.E.; Gilpatrick, J.D. Los Alamos National Lab., NM (United States). [1993]. 4p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930511–6: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93012742. Source: OSTI; NTIS; GPO Dep.

A logarithmic-ratio beam position monitor (BPM) circuit has been designed that operates directly from radio frequency- signals in the 100-MHz to 500-MHz frequency range. The circuit uses four logarithmic amplifiers, a pair for each channel. One amplifier per

channel receives its signal input directly from a BPM electrode while the second amplifier receives the same signal attenuated by 7-dB. The two outputs of each channel are summed together and the composite video outputs are applied to a differencing amplifier. The net result is the logarithmic-ratio position measurement derived from the two input rf signals. Paralleling the pairs of outputs from the amplifiers provides measurement accuracy that is comparable to other circuit techniques used for position measurement.

24373 (LA-UR–93-1873) **Operational characteristics of a 100-mA, 2-MeV radio-frequency quadrupole.** Johnson, K.F.; Cottingame, W.B.; Bolme, G.O.; Fortgang, C.M.; Ingalls, W.B.; Marquardt, J.; Rusthoi, D.P.; Sander, O.R.; Smith, M.; Worth, G.T. Los Alamos National Lab., NM (United States). [1993]. 4p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930511–47: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93014474. Source: OSTI; NTIS; INIS; GPO Dep.

A 100-mA, 2.07-MeV Radio-Frequency Quadrupole (RFQ III) has been commissioned and operated routinely on the Accelerator Test Stand (ATS) [1] at Los Alamos National Laboratory. To characterize the RFQ output beam dynamics, measurements were made of the beam transmission and of the transverse and longitudinal phase-space distributions. Data were taken for different RFQ III operating conditions and compared to simulations.

24374 (LA-UR–93-1903) **Hydrodynamic calculations of 20-TeV beam interactions with the SSC beam dump.** Wilson, D.C. (Los Alamos National Lab., NM (United States)); Wingate, C.A.; Goldstein, J.C.; Godwin, R.P.; Mokhov, N.V. Los Alamos National Lab., NM (United States). [1993]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930511–44: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93014463. Source: OSTI; NTIS; INIS; GPO Dep.

The 300 μs, 400 MJ SSC proton beam must be contained when extracted to the external beam dump. The current design for the SSC beam dump can tolerate the beat load produced if the beam is deflected into a raster scan over the face of the dump. If the high frequency deflecting magnet were to fail, the beam would scan a single strip across the dump face resulting in higher local energy deposition. This could vaporize some material and lead to high pressures. Since the beam duration is comparable to the characteristic time of expected hydrodynamic motions, we have combined the static energy deposition capability of the MARS computer code with the two- and three-dimensional hydrodynamics of the MBA and SPHINX codes. EOS data suggest an energy deposition threshold of 15 kJ/g, below which hydrodynamic effects are minimal. Above this our 2D calculations show a hole boring rate of 7 cm/μs for the nominal beam, and pressures of a few kbar. Scanning the nominal beam faster than 0.08 cm/μs should minimize hydrodynamic effects. 3D calculations support this.

24375 (LA-UR–93-1947) **Funneling experience at Los Alamos: Experiments and designs.** Jason, A.J.; Johnson, K.F.; Nath, S. Los Alamos National Lab., NM (United States). [1993]. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9305177–6: 12. International collaboration of advanced neutron sources meeting (ICANS), Abingdon (United Kingdom), 24-28 May 1993). Order Number DE93014357. Source: OSTI; NTIS; GPO Dep.

Modern linacs are capable of accelerating high-current low-emittance beams input above a minimum energy. However, the ability of ion sources to produce such beams and the ability of low energy structures to accelerate high currents to this minimum energy is lacking. Funneling is a method of combining two or more beams to overcome this limitation. It is very important to note that the phase space of the two beams to be combined is not merged, in violation of Liouville's theorem. Instead beam micropulses from two sources are interleaved in time. It is also important to note that the micropulse frequency has doubled over that of the separate sources and must be accommodated by the linac following the funnel. Thus if the two funneled beams were accelerated by 400 MHz linacs, further acceleration must be done by an 800 MHz (or higher) linac. Other concepts are possible, but the authors concentrate on the one presented as the most feasible. The presence of both longitudinal and transverse focusing elements are crucial to device performance, as are adequate diagnostic elements. To attain the high peak currents needed for Los Alamos projects, such as the Ground Test Accelerator (GTA), Accelerator Production of Tritium (APT), Accelerator Transmutation of Waste (ATW), or the 5 MW upgrade to the National Center for Neutron Research (NCNR), a funneling scheme is needed. In these projects the authors consider funneling of two beams with peak currents of up to 100 mA and transverse emittances of the order of 0.02π cm mrad, rms normalized. This article discusses a funneling experiment done at Los Alamos and briefly mentions a program at another institution that has demonstrated the concept. The authors will also discuss the funnel design for APT, now undergoing conceptual design.

24376 (LA-UR–93-2040) **Polarization diagnostics and optical pumping development for OPPIS and LAMPF.** Swenson, D.R.; Tupa, D.; York, R.L.; Dulick, M.; van Dyck, O.B. Los Alamos National Lab., NM (United States). 21 May 1993. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930544–1: Conference on polarized ion sources and polarized gas targets, Madison, WI (United States), 23-27 May 1993). Order Number DE93014390. Source: OSTI; NTIS; INIS; GPO Dep.

We report improvement of the polarization diagnostics and their use in the development of the Optically Pumped Polarized Ion Source (OPPIS).

24377 (LBL–32480) **Theoretical examination of transfer cavities in a standing-wave free- electron laser Two-Beam Accelerator.** Govil, R.; Sessler, A. Lawrence Berkeley Lab., CA (United States). Jan 1993. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. (ESG–198;CONF-930159–29: OE/LASE '93: International Society for Optical Engineering (SPIE) conference, Los Angeles, CA (United States), 16-23 Jan 1993). Order Number DE93010462. Source: OSTI; NTIS; INIS; GPO Dep.

Recent analysis of the Two-Beam Accelerator (TBA) by Wurtele, Whittum and Sessler has shown that the transfer cavities, both in the relativistic klystron version (RK/TBA) and the standing-wave free-electron laser version (SWFEL/TBA), can be characterized by a simple coupling impedance. In the two cases the radiation process is very similar: Only the modes that couple to the electron beam are different. As a result, computer programs that are able to handle realistic cavities (with beam ports and coupling ports, etc.) can be employed to evaluate the performance of either version of the TBA. We have employed the code URMEL to study the proper coupling impedance for a number of realistic cavities for a SWFEL.

24378 (NIIEFA-P-V–0852) **Countercurrent converters for beam current measurement and determination of the position of its center of gravity in a induction linear accelerator.** Demskij, M.I.; Trifonov, D.E.; Ul'yanov, V.I. Nauchno-Issledovatel'skij Inst. Ehlektrofizicheskoj Apparatury, Leningrad (Russian Federation). 1990. [8p.] (In Russian). Order Number DE93626177. Source: OSTI; NTIS (US Sales Only); INIS.

Consideration is given to main choosing criteria and calculation relations for current transformers, used in countercurrent converters at beam current pulse durations, typical for induction linear accelerators. Three versions of design of countercurrent transducers with current transformers are analyzed. Merits and demerits of the designs are shown. 2 refs.; 4 figs.

24379 (ORNL/FTR–4284) **Travel to Italy to participate in a particle accelerator conference: Foreign trip report, May 30, 1992–June 6, 1992.** Jones, N.L. Oak Ridge National Lab., TN (United States). 17 Jun 1992. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93011066. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The traveler attended the Sixth International Conference on Electrostatic Accelerators and Associated Boosters, and presented a poster on "Improved Voltage Gradient Control System For Electrostatic Accelerators." Papers of particular interest to the ORNL atomic physics program involved the acceleration of carbon

clusters, computer modeling of Bremsstrahlung radiation from accelerator tubes, and cooled ion beam physics. One session of the conference, conducted at Laboratori Nazionali di Legnaro, included a tour of the 15 million volt XTU Tandem accelerator and the booster linac which is still under construction.

24380 (SLAC-PUB–6060) **Polarized source performance in 1992 for SLC–SLD.** Schultz, D.; Alley, R.; Clendenin, J.; Frisch, J.; Garden, C.; Hoyt, E.; Klaisner, L.; Kulikov, A.; Prescott, C.; Saez, P.; Tang, H.; Turner, J.; Wicks, M.; Woods, M.; Yeremian, D.; Zolotorev, M. Stanford Linear Accelerator Center, Menlo Park, CA (United States). Feb 1993. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00515. (CONF-921131–11: 10. international symposium on high-energy spin physics, Nagoya (Japan), 9-14 Nov 1992). Order Number DE93010951. Source: OSTI; NTIS; INIS; GPO Dep.

In its initial operation, the SLC Polarized Electron Source successfully met the SLC goals for 1992 for intensity and efficiency. However, the stability of the beam at the source was marginal, and the polarization was only ~28%. The SLC goal to provide > 10,000 Z events for the SLD from polarized electrons was met.

24381 (SLAC-PUB–6061) **Exploiting periodicity and other structural symmetries in field solvers.** Nelson, E.M. Stanford Linear Accelerator Center, Menlo Park, CA (United States). Feb 1993. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00515. (CONF-930269–11: Computational accelerator physics conference (CAP93), Pleasanton, CA (United States), 22-26 Feb 1993). Order Number DE93010952. Source: OSTI; NTIS; INIS; GPO Dep.

Many RF structures have symmetries which can be exploited by field solvers with appropriate boundary conditions. These symmetries allow a reduced problem to be solved, which leads to faster and/or more accurate solutions. Of particular interest to the accelerator community are periodic structures. Quasi-periodic boundary conditions allow modes with any desired phase advance given a single cell of the periodic structure. For symmetric periodic structures there is a variation which requires only a half cell of the periodic structure. These boundary conditions can also be used for rotationally periodic structures, such as cross-field amplifiers and magnetrons. Boundary conditions for some other symmetries, such as reflection symmetry about a plane and about a point, will also be reviewed.

24382 (SLAC-PUB–6067) **Modelling RF sources using 2-D PIC codes.** Eppley, K.R. Stanford Linear Accelerator Center, Menlo Park, CA (United States). Mar 1993. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00515. (CONF-930269–10: Computational accelerator physics conference (CAP93), Pleasanton, CA (United States), 22-26 Feb 1993). Order Number DE93010954. Source: OSTI; NTIS; INIS; GPO Dep.

In recent years, many types of RF sources have been successfully modelled using 2-D PIC codes. Both cross field devices (magnetrons, cross field amplifiers, etc.) and pencil beam devices (klystrons, gyrotrons, TWT'S, lasertrons, etc.) have been simulated. All these devices involve the interaction of an electron beam with an RF circuit. For many applications, the RF structure may be approximated by an equivalent circuit, which appears in the simulation as a boundary condition on the electric field ("port approximation"). The drive term for the circuit is calculated from the energy transfer between beam and field in the drift space. For some applications it may be necessary to model the actual geometry of the structure, although this is more expensive. One problem not entirely solved is how to accurately model in 2-D the coupling to an external waveguide. Frequently this is approximated by a radial transmission line, but this sometimes yields incorrect results. We also discuss issues in modelling the cathode and injecting the beam into the PIC simulation.

24383 (SSCL–619) **Submicron beam position sensor for the SSC.** Tsyganov, E.; Kauffmann, S.; Meinke, R.; Nexsen, W.; Richardson, R. Superconducting Super Collider Lab., Dallas, TX (United States). Mar 1993. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. Order Number DE93013943. Source: OSTI; NTIS; INIS; GPO Dep.

A submicron-accuracy beam position monitor for the Superconducting Super Collider accelerators is proposed, based on use of a low-energy electron beam probe. The resolution of the probe is estimated.

24384 (SSCL-Preprint–203) **An experimental evaluation of joint electrical resistance on power lead thermal performance.** Datskov, V.I.; Demko, J.A.; Augustynowicz, S.D.; Hutton, R.D. Superconducting Super Collider Lab., Dallas, TX (United States). Mar 1993. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-930537–10: 5. annual international industrial symposium on the Super Collider and exhibition, San Francisco, CA (United States), 6-8 May 1993). Order Number DE93012306. Source: OSTI; NTIS; INIS; GPO Dep.

The amount of electrical resistance in braze joints is not known for certain. In addition annealing processes that occurs during a braze or solder operation can change the residual resistivity ratio (RRR) of the copper. The change in the electrical resistivity of samples of copper because of exposure to conditions that a high current lead would see during a brazing operation were experimentally investigated. A sample was taken from a manufacturing and brazing trial of the high current power leads for the Superconducting Super Collider (SSC), and from oxygen free high conductivity copper (OFHC) 101 rod similar to that used in the trial. The samples were heated under conditions that a current lead would undergo during the brazing process. Measurements were made of the electrical resistance of the copper specimens and across abraze joint in the manufacturing trial sample for temperatures ranging from liquid helium to room temperature.

24385 (SSCL-Preprint–208) **Systems analysis determining critical items, critical assembly processes, primary failure modes and corrective actions on ASST magnets.** Arden, C.S. Superconducting Super Collider Lab., Dallas, TX (United States). Apr 1993. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-930537–2: 5. annual international industrial symposium on the Super Collider and exhibition, San Francisco, CA (United States), 6-8 May 1993). Order Number DE93012305. Source: OSTI; NTIS; INIS; GPO Dep.

During the assembly process through the completion of the Accelerator Surface String Test (ASST) phase one test, Magnet Systems Division Reliability Engineering has tracked all the known discrepancies utilizing the Failure Reporting, Analysis and Corrective Action System (FRACAS) and data base. This paper discusses the critical items, critical assembly processes, primary failure modes and corrective actions (lessons learned) based on actual data for the ASST magnets. The ASST magnets include seven Brookhaven Lab Dipoles (DCA-207 through 213), fourteen Fermi Lab Dipoles (DCA-310 through 323) and five Lawrence Berkeley Lab Quadrupoles (QCC-402 through 406). Between all the ASST magnets built there were one hundred eighty six (186) class one discrepancies reported out of approximately eleven hundred total discrepancy reports. The class one or critical discrepancies are defined as form, fit, function, safety or reliability problem. Each and every ASST magnet is considered a success, as they all achieved the quench performance requirements and were capable of being incorporated into the string test. This paper also discuss some specific magnet discrepancies, including failure cause(s), corrective action and possible open issues.

24386 (SSCL-Preprint–210) **Stress analysis on SSC cryogenic shaft transfer line suspension system.** Zhang, B. Superconducting Super Collider Lab., Dallas, TX (United States). Apr 1993. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-930537–11: 5. annual international industrial symposium on the Super Collider and exhibition, San Francisco, CA (United States), 6-8 May 1993). Order Number DE93014073. Source: OSTI; NTIS; INIS; GPO Dep.

Short communication. SUPERCONDUCTING SUPER COLLIDER/refrigerating machinery; SUPPORTS/stress analysis; REFRIGERATING MACHINERY/supports; CRYOGENICS; SUPPORTS; FINITE ELEMENT METHOD

24387 (SSCL-Preprint–215) **A study on sector nitrogen inventory emergency venting.** Zhang, B. Superconducting Super Collider Lab., Dallas, TX (United States). Apr 1993. 5p. Sponsored

by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-930537–6: 5. annual international industrial symposium on the super collider and exhibition, San Francisco, CA (United States), 6-8 May 1993). Order Number DE93012304. Source: OSTI; NTIS; INIS; GPO Dep.

The main ring of the Superconducting Super Collider consists of 10 sectors. Each sector has 4 strings and the total nitrogen inventory in a nominal string (4,320 m) is approximately 8,856 kg (2,894 gal). There are occasions when part of the collider nitrogen inventory needs to be vented in an emergency fashion. Due to the large quantity of the nitrogen inventory and the high elevation differential between the below-ground collider ring and the above-ground vent stack, it is essential to vent the nitrogen inventory in the vapor phase. Uninsulated dump tanks are provided at all sites to collect and vaporize liquid nitrogen expelled from the strings. Vapor nitrogen is then vented through a vent stack at surface level into the atmosphere. An emergency venting starts when a remote control valve in the nitrogen subcooler box opens. The string nitrogen inventory is then discharged into the dump tank. Around 100 kg nitrogen inventory will be discharged before the string inventory reaches a saturation state at certain location. After that, the static heat leak into the 80 K circuit (16,250 W per string) becomes the dominating driving force to expel the nitrogen inventory. Due to the length of the string, the boil-off bubbles are localized. The mass boil-off rate is translated into a much higher mass flow rate expelled from the string. The string saturation pressure is dynamically balanced by the total pressure drop between the string and the vent stack. The capacity requirement for the nitrogen dump tank reaches the maximum when the dump tank at each site has to handle the nitrogen inventory in two strings, which is approximately 17,712 kg (5,788 gal). This work is intended to analyze the volume capacity requirement for the nitrogen dump tanks for this worst scenario. A computer program is developed to numerically simulate the emergency venting process. The string, dump tank, and venting paths are modeled individually and then linked to impose the constraints.

24388 (SSCL-Preprint–216) **Preliminary design of sector cryogenic shaft transfer line system.** Zhang, B.; Stifle, K. Superconducting Super Collider Lab., Dallas, TX (United States). Apr 1993. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-930537–3: 5. annual international industrial symposium on the Super Collider and exhibition, San Francisco, CA (United States), 6-8 May 1993). Order Number DE93012303. Source: OSTI; NTIS; INIS; GPO Dep.

This work summarizes the preliminary design of the shaft transfer line. Operating mod dictating the design criteria are addressed. System requirements, design constraints, and results design analysis conducted on key elements are also discussed.

24389 (SSCL-Preprint–219) **Leak Checker Data Acquisition System.** Payne, J.; Gannon, J. Superconducting Super Collider Lab., Dallas, TX (United States). Apr 1993. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-9305171–1: Computational accelerator particle conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93011039. Source: OSTI; NTIS; INIS; GPO Dep.

A portable, high speed, computerized, data logging system. The primary function of this system is to collect 'Helium Readings' from mass spectrometers. This system monitors up to 14 mass spectrometers, operating from as far away as 1 kilometer, or clustered to isolate a helium leak within 20cm. Data logging enables technicians to witness the flight of the helium through the magnet string by a graphical plotting of every channel within microseconds of when the helium was released into the vacuum. The readings are used to locate vacuum leaks and provide acceptance testing of the vacuum system for a string of superconducting magnets. The secondary functions of this system are the documentation of test conditions, archiving data sets for future reference, and providing a real-time display of all channels as the string of magnets approach critical test conditions.

24390 (SSCL-Preprint–226) **Low conductivity water plants – issues of process control.** Baritchi, L.; Haenni, D. Superconducting Super Collider Lab., Dallas, TX (United States). Apr 1993. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-930537–4: 5. annual international industrial symposium on the Super Collider and exhibition, San Francisco, CA (United States), 6-8 May 1993). Order Number DE93012301. Source: OSTI; NTIS; INIS; GPO Dep.

The SSC Laboratory will require a large number of widely distributed low conductivity water (LCW) cooling systems to support accelerator operations. In addition to designing the physical plants, plans mustbe made for control/information systems and the human organization to run them. Initial considerations in these areas are presented.

24391 (SSCL-Preprint–228) **SSCL DD2 driver port and project update.** Mestad, S.L. Superconducting Super Collider Lab., Dallas, TX (United States). Apr 1993. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-930537–36: 5. annual international industrial symposium on the Super Collider and exhibition, San Francisco, CA (United States), 6-8 May 1993). Order Number DE93014171. Source: OSTI; NTIS; INIS; GPO Dep.

A paper previously published in the 1992 ICHEP proceedings outlined the SSC's need for a high speed, high capacity tape drive to store detector data. Also described were stages and lessons learned while developing a custom device driver for the Ampex DD2 tape drive on a Silicon Graphics 4D/310. This paper updates the work on the SGI driver and describes the efforts in porting the driver to a Sun Microsystems 670 server.

24392 (SSCL-Preprint–235) **Supplier Performance Evaluation and Rating System (SPEARS).** Oged, M.; Warner, D.; Gurbuz, E. Superconducting Super Collider Lab., Dallas, TX (United States). Mar 1993. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-930537–7: 5. annual international industrial symposium on the Super Collider and exhibition, San Francisco, CA (United States), 6-8 May 1993). Order Number DE93012299. Source: OSTI; NTIS; INIS; GPO Dep.

The SSCL Magnet Quality Assurance Department has implemented a Supplier Performance Evaluation and Rating System (SPEARS) to assess supplier performance throughout the development and production stages of the SSCL program. The main objectives of SPEARS are to promote teamwork and recognize performance. This paper examines the current implementation of SPEARS. MSD QA supports the development and production of SSCsuperconducting magnets while implementing the requirements of DOE Order 5700.6C. The MSD QA program is based on the concept of continuous improvement in quality and productivity. The QA program requires that procurement of items and services be controlled to assure conformance to specification. SPEARS has been implemented to meet DOE requirements and to enhance overall confidence in supplier performance. Key elements of SPEARS include supplier evaluation and selection as well as evaluation of furnished quality through source inspection, audit, and receipt inspection. These elements are described in this paper.

24393 (SSCL-Preprint–237) **The Accelerator Systems String Test cryogenics.** Mulholland, G.T. Superconducting Super Collider Lab., Dallas, TX (United States). Apr 1993. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-930537–34: 5. annual international industrial symposium on the Super Collider and exhibition, San Francisco, CA (United States), 6-8 May 1993). Order Number DE93014075. Source: OSTI; NTIS; INIS; GPO Dep.

The ASST magnet string cryogenic refrigeration requirements were planned around an original design and a much smaller, backup, He refrigeration system. The ASST schedule required that the backup, or Plan B, helium refrigerator provide and meet all the requirements of the milestone test. The Plan B design, layout, subsystem commissioning tests, and the performance schedule will be provided. The magnet string cryogenic system pump and purge, cooldown and warmup, central and multiple shield cooling, temperature control and subcooling, and recooler operating experience are reported. The ASST cryogenic system static performance and the dynamic provisions, response, and recovery to magnet quenches will be described.

24394 (SSCL-Preprint–244) **Quench simulation of the 40 mm aperture SSC-Quadrupole Magnet connected in series with 50 mm aperture SSC-Dipole Magnets.** Lopez, G. Superconducting Super Collider Lab., Dallas, TX (United States). May 1993. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-930511–119: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93014258. Source: OSTI; NTIS; INIS; GPO Dep.

The hot-spot temperature is estimated for a Collider Quadrupole Magnet (CQM) connected in series with collider Dipole Magnets (CDM's) and for a quench appearing in CQM. An active protection system is studied where all magnets except the CQM's have heaters. These heaters cause a spot quench in each of the CDM outer layer conductors. Results indicate that the scheme is safe for a total induced quench time delay of less than 230 ms.

24395 (SSCL-Preprint–245) **The longitudinal coupling impedance of a slot on the SSC Collider linear.** Thiagarajan, V. Superconducting Super Collider Lab., Dallas, TX (United States). May 1993. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-930511–17: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93014179. Source: OSTI; NTIS; INIS; GPO Dep.

The location of a liner inside the collider beam tube is being studied at the SSC Laboratory, in order to provide a synchrotron radiation intercept and to help enhance the vacuum. There will be wake fieldspropagating inside the liner following the beam fields incident on the pumping holes/slots on the liner. The effect of the wake fields may be expressed through coupling impedances. This paper describes a methodto evaluate the longitudinal coupling impedance of slots/holes on the liner for a large range of frequencies (0–60 GHz).

24396 (SSCL-Preprint–260) **Three-dimensional model of a liquid-cooled, low energy booster radio- frequency cavity tuner at the Superconducting Super Collider.** Ranganathan, R.; Propp, A.; Campbell, B.; Dao, B. Superconducting Super Collider Lab., Dallas, TX (United States). Apr 1993. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-930537–14: 5. annual international industrial symposium on the Super Collider and exhibition, San Francisco, CA (United States), 6-8 May 1993). Order Number DE93014247. Source: OSTI; NTIS; INIS; GPO Dep.

A three-dimensional computational heat transfer and fluid flow model was developed to analyze a forced-flow, liquid-cooled, low energy booster (LEB) radio-frequency (RF) cavity tuner concept. The results for a commercial dielectric heat transfer fluid indicated safe temperatures in the ferrite.

24397 (SSCL-Preprint–262) **Structural and thermal analysis of a solid-cooled, low energy booster, radio-frequency-cavity tuner at the Superconducting Super Collider.** Ranganathan, R.; Propp, A.; Dao, B.; Campbell, B. Superconducting Super Collider Lab., Dallas, TX (United States). Apr 1993. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-930537–19: 5. annual international industrial symposium on the Super Collider and exhibition, San Francisco, CA (United States), 6-8 May 1993). Order Number DE93014141. Source: OSTI; NTIS; INIS; GPO Dep.

A three-dimensional heat conduction and structural model was developed to analyze and optimize the design of a solid-cooled low energy booster (LEB) radio-frequency (RF) cavity tuner concept. Consideration was given to three cooling options: (1) using beryllium oxide (BeO) disks, (2) using aluminum nitride (A1N) disks and (3) using neither BeO nor AIN disks. The results indicate that solid cooling is feasible from thermal and structural viewpoints if a minimum of two BeO disks or four AIN disks are used.

24398 (SSCL-Preprint–263) **Method of fabricating a completely ordered wound coil.** Mookerjee, S.; Shen, W.; Yager, B. Superconducting Super Collider Lab., Dallas, TX (United States). Apr 1993. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-930537–20: 5. annual international industrial symposium on the Super Collider and exhibition, San Francisco, CA (United States), 6-8 May 1993). Order Number DE93014142. Source: OSTI; NTIS; INIS; GPO Dep.

An innovative four step coil winding process is under development at the Superconducting Super Collider Laboratory. This method is to be used for correction coils used in magnets for the HEB and Collider Rings of the SSC. High density, orderly wound coils with good mechanical stability and dimensional control are the end products of this technique.

24399 (SSCL-Preprint–264) **Low energy booster radio frequency cavity structural analysis.** Jones, K. Superconducting Super Collider Lab., Dallas, TX (United States). Apr 1993. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-930537–13: 5. annual international industrial symposium on the Super Collider and exhibition, San Francisco, CA (United States), 6-8 May 1993). Order Number DE93014246. Source: OSTI; NTIS; INIS; GPO Dep.

The structural design of the Superconducting Super Collider Low Energy Booster (LEB) Radio Frequency (RF) Cavity is very unique. The cavity is made of three different materials which all contribute to its structural strength while at the same time providing a good medium for magnetic properties. Its outer conductor is made of thin walled stainless steel which is later copper plated to reduce the electrical losses. Its tuner housing is made of a fiber reinforced composite laminate, similar to G10, glued to stainless steel plating. The stainless steel of the tuner is slotted to significantly diminish the magnetically-induced eddy currents. The composite laminate is bonded to the stainless steel to restore the structural strength that was lost in slotting. The composite laminate is also a barrier against leakage of the pressurized internal ferrite coolant fluid. The cavity's inner conductor, made of copper and stainless steel, is subjected to high heat loads and must be liquid cooled. The requirements of the Cavity are very stringent and driven primarily by deflection, natural frequency and temperature. Therefore, very intricate finite element analysis was used to complement conventional hand analysis in the design of the cavity. Structural testing of the assembled prototype cavity is planned to demonstrate the compliance of the cavity design to all of its requirements.

24400 (SSCL-Preprint–273) **Design and preliminary testing of the LEB extraction kicker magnet at the SSC.** Anderson, D.E.; Schneider, L.X. Superconducting Super Collider Lab., Dallas, TX (United States). May 1993. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-930511–33: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93014137. Source: OSTI; NTIS; INIS; GPO Dep.

The kicker magnet for extracting beam out of the Low Energy Booster is required to generate an integrated field of 0.06 T-m for 2 μs, rising from 1% to 99% of peak in $\lesssim$80 ns. Technologies for pulsed magnets of this variety, along with the engineering tradeoffs of each, will be presented. Details of the electrical design of a vacuum-insulated 25-Ω travelling-wave (TW) kicker magnet, with a 5 x 7 cm ferrite aperture, will be discussed. The results of low-voltage tests of the prototype TW magnet and a solid-core design will also be presented. Application of experimental data and design theory to the magnet design will be mentioned.

24401 (SSCL-Preprint–277) **Effective stress of a 4.2 K beam tube in a quenching collider 50 mm dipole magnet for the SSC.** Leung, K.; Shu, Q.; Snitchler, G.; Yu, K.; Zbasnik, J. Superconducting Super Collider Lab., Dallas, TX (United States). May 1993. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-930511–22: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93014182. Source: OSTI; NTIS; INIS; GPO Dep.

Two mechanical design requirements are defined for the SSC Collider beam tube. First, the vacuum requirement (luminosity lifetime = 150 hrs). It requires the design of a pressure boundary within the cold mass vessel to provide a vacuum tunnel for the proton beam and to minimize the synchrotron radiation gas desorbtion with a suitable material. The Collider beam tube design is under an intensive activity to search for a material that will meet the luminosity requirement without a distributed pump or liner. Second is the tube wall's resistivity requirement (σ*t = 2E5 Ω^{-1}). For a 4.2 K

beam tube the Cu thickness is 100 μm (RRR=30,6.7 T, σ=2E9$\Omega^{-1}m^{-1}$). The copper yield strength is relatively low in comparison to steel and, therefore, the design of the steel layer is governed by the copper layer yield stress limit. A beam tube subjected to eddy current load in a quenching dipole requires an optimum diameter design to provide maximum aperture and adequate cooling space for the liquid Helium flow to cool the beam tube. This paper presents a mechanical design procedure using an established finite element analysis and modeling method to produce a design with safety, matching the dipole cold mass vessel as designed by the ASME code, and to generate a steel tube wall thickness to ensure the copper coating stress below the yield stress limit in a quenching dipole.

24402 (SSCL-Preprint–279) **Conceptual design of the cryostat system for the 2:1 vertical bending dipole magnet of the SSC collider ring.** Jalloh, A.R. (Superconducting Super Collider Lab., Dallas, TX (United States)); Corbett, C.; Chang, C.J.; Baritchi, D.; Chen, S.; Riddle, J.; Gruzdeva, Z.; Daly, E. Superconducting Super Collider Lab., Dallas, TX (United States). Apr 1993. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-930537–25: 5. annual international industrial symposium on the Super Collider and exhibition, San Francisco, CA (United States), 6-8 May 1993). Order Number DE93014174. Source: OSTI; NTIS; INIS; GPO Dep.

This paper presents the various conceptual designs that were investigated to determine a feasible cryostat system for BV1. The three concepts investigated for this work were: (1) Two separate collider dipole magnets with a rotated upper magnet; (2) Elliptocylindrical vacuum vessel; (3) Cylindrical vacuum vessel. Each of these concepts is discussed in the following sections. It should be pointed out that detailed engineering analyses to study the thermal and structural performance characteristics of the various concepts have not been carried out. These analysis will be done when the design requirements are available. A cylindrical vacuum vessel design was the recommended design for the 2:1 cryostat system.

24403 (SSCL-Preprint–280) **Design and analysis of the cryostat system for a 15 m long prototype quadrupole magnet.** Jalloh, A. (Superconducting Super Collider Lab., Dallas, TX (United States)); Corbett, C.; Chang, C.; Baritchi, D.; Bagwell, S.; Chen, S.; Riddle, J.; Daly, E. Superconducting Super Collider Lab., Dallas, TX (United States). Apr 1993. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-930537–24: 5. annual international industrial symposium on the Super Collider and exhibition, San Francisco, CA (United States), 6-8 May 1993). Order Number DE93014133. Source: OSTI; NTIS; INIS; GPO Dep.

Quadrupole magnets with a gradient of 190 T/m are required in several sections of the interaction region of the SSC collider ring. These magnets have an aperture of 50-mm and greater and they are expected to operate at 4.3 K. They vary in length from approximately 6 m to about 15 m. Superconducting magnets with a 50-mm aperture and 15-m length have never been built before. It is necessary to develop and prove out the design and technology for long quadrupole magnets before embarking on the design of tunnel magnets of similar design. A research and development program was initiated in January 1992 in the Magnet SystemsDivision of the SSC Laboratory to develop such a magnet. The goal of this R&D program was to develop a producible and cost effective magnet design and fabrication process that can satisfy performance needs. Thebaseline design is the 50-mm Dipole Cryostat developed at Fermi National Accelerator Laboratory. Attempts were made to improve upon baseline design wherever this was feasible. This paper presents the design that was developed for the cryostat system of the prototype quadrupole magnet.

24404 (SSCL-Preprint–282) **Test performance of the QSE series of 5 cm aperture quadrupole model magnets.** Archer, B.; Bein, D.; Cunningham, G.; DiMarco, J.; Gathright, T.; Jayakumar, J.; Labarge, A.; Li, W.; Lambert, D.; Scott, M.; Snitchler, G.; Zeigler, R. Superconducting Super Collider Lab., Dallas, TX (United States). Apr 1993. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-930537–23: 5. annual international industrial symposium on the Super Collider and exhibition, San Francisco, CA (United States), 6-8 May 1993). Order Number DE93014173. Source: OSTI; NTIS; INIS; GPO Dep.

A 5 cm aperture quadrupole design, the QSE series of magnets were the first to be tested in the Short Magnet and Cable Test Laboratory (SMCTL) at the SSCL. Test performance of the first two magnets of the series are presented, including quench performance, quench localization, strain gage readings, and magnetic measurements.Both magnets behaved reasonably well with no quenches below the collider operating current, four training quenches to plateau, and good training memory between thermal cycles. Future magnets in the QSE series will be used to reduce the initial training and to tune out unwanted magnetic harmonics.

24405 (SSCL-Preprint–296) **Simulation of the transverse dipole mode multibunch instability for the SSC Collider.** Chen, S.; Lopez, G. Superconducting Super Collider Lab., Dallas, TX (United States). May 1993. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-930511–80: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93014010. Source: OSTI; NTIS; INIS; GPO Dep.

We investigate a simulation code to study the transverse dipole mode multibunch instability due to a single RF cavity and the resistive wall for the Superconducting Super Collider. The growth time calculated from our code agrees well with analytical calculations (ZAP code). The code can be used for studying the interplay of wake field, noise and feedback system, i.e. for design the feedback system.

24406 (SSCL-Preprint–305) **Parameters and conceptual design of a vertical bending magnet for the Super Collider.** Goodzeit, C.; Jayakumar, R.; Nobrega, F.; Snitchler, G.; Stiening, R. Superconducting Super Collider Lab., Dallas, TX (United States). Apr 1993. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-930537–43: 5. annual international industrial symposium on the Super Collider and exhibition, San Francisco, CA (United States), 6-8 May 1993). Order Number DE93014077. Source: OSTI; NTIS; INIS; GPO Dep.

Special dipole magnets are required near the intersection regions of the Supercollider to bend the beams in the vertical plane so that they can be made to converge for collision. This paper presents the design requirements and parameters for one of these magnets (the BV1C splitter) along with the magnetic design and conceptual mechanical design for the cold mass.

24407 (SSCL-Preprint–309) **Structural behavior of the six-strut support system.** Dao, B. Superconducting Super Collider Lab., Dallas, TX (United States). Apr 1993. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-930537–22: 5. annual international industrial symposium on the Super Collider and exhibition, San Francisco, CA (United States), 6-8 May 1993). Order Number DE93014177. Source: OSTI; NTIS; INIS; GPO Dep.

A simple mathematical model was used to understand the structural behavior of the six-strut support system. By breaking the system into symmetry and antisymmetry configurations, the vertical and torsional displacements were decoupled, thus making simple calculations possible.

24408 (SSCL-Preprint–311) **Using a ceramic chamber in kicker magnets.** Kurennoy, S. Superconducting Super Collider Lab., Dallas, TX (United States). May 1993. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-930537–46: 5. annual international industrial symposium on the Super Collider and exhibition, San Francisco, CA (United States), 6-8 May 1993). Order Number DE93014068. Source: OSTI; NTIS; INIS; GPO Dep.

A ceramic chamber inside kicker magnets can provide the relevant field risetime. On the other hand, some metallic coating inside has to prevent static charge buildup and shield the beam from ceramic and ferrite at high frequencies to avoid possible resonances. The issues concerning the metallized ceramic chamber, such as coupling impedances and requirements on the coating, are studied to find a compromise solution for kickers of the Medium Energy Booster at the Superconducting Super Collider.

24409 (SSCL-Preprint–318) **Reducing the energy requirements of quench protection heaters for SSC dipoles – Test results.** Haddock, C. (Superconducting Super Collider Lab., Dallas, TX (United States)); Kuzminski, J.; Orris, D.; Mazur, P. Superconducting Super Collider Lab., Dallas, TX (United States). Apr 1993. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-930537–21: 5. annual international industrial symposium on the Super Collider and exhibition, San Francisco, CA (United States), 6-8 May 1993). Order Number DE93014135. Source: OSTI; NTIS; INIS; GPO Dep.

Design considerations and first test results of quench protection heaters for Superconducting Collider (SSC) collider dipole magnets have been presented in earlier papers. The heaters have been shown to fully protect the magnet against excessive peak temperature which would represent damage to the superconducting coil. Installation and operation of the heaters does not place the magnet at any increased risk of failure, since the energy densities applied are relatively low ($\sim$1J/cm^2) and the construction technique was made as simple as possible. The energy required by the heaters in order to protect the magnet is considerably larger than that amount estimated during the planning of the collider ring protection scheme. Therefore, three tong magnets following the Accelerator Systems Sizing Test (ASST) construction series at Fermi National Accelerator Laboratory were made available for quench protection heater "R&D" studies. All of the ASST series magnets deliberately kept the high energy requirement heaters for the purpose of commonality for the string test. This paper describes the results of the "R&D" heater tests and the amount of energy reduction achieved. It is shown that it has been possible to reduce the heater energy requirement to a value below therefore potentially save collider cost.

24410 (SSCL-Preprint–320) **Strain gauge pack in process measurement system for the collider quadrupole, design and technology transfer.** Ziegler, R.E. (Superconducting Super Collider Lab., Dallas, TX (United States)); Bein, D.; Brooks, L.; Garza, M.; Rodgers, B.; Novak, G. Superconducting Super Collider Lab., Dallas, TX (United States). May 1993. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-930511–79: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93014011. Source: OSTI; NTIS; INIS; GPO Dep.

The in process measurement system that is described below was designed to monitor the strain gauge instrumentation collar pack during all phases of quadrupole magent manufacture. The primary goal was to implement a monitoring system that incorporated standard measurement techniques while maintaining signal integrity. The flexibility and robustness required in a production environment were taken into account throughout the design and implementation. All major components were chosen from commercially available supplies. The driving software was chosen to provide a user friendly interface while keeping software development efforts to a minimum without sacrificing adaptability.

24411 (SSCL-Preprint–326) **Design status report on the collider utility straight insertions.** Parker, B. Superconducting Super Collider Lab., Dallas, TX (United States). May 1993. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-930511–25: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93014269. Source: OSTI; NTIS; INIS; GPO Dep.

The lattice for the rings of the Superconducting Super Collider is divided into arcs, a FODO array of superconducting quadrupoles and dipoles; interaction regions, places where the beams are focused and brought into collision within physics detectors; and utility sections, places where injection, acceleration, abort, halo-scraping, and other control and diagnostic functions are performed. Recent modifications to the utility region design are reported here. Briefly these include lowering injection B-maxima by 40%; reducing the lengths and varieties of superconducting quadrupoles; improving conditions for injection matching; increasing abort admittance; mitigating component interferences; and identifying places for dampers and other beam instrumentation.

24412 (SSCL-Preprint–327) **The heat load of an 80 K liner for the SSC.** Maddocks, J.; Yuecel, A. Superconducting Super Collider Lab., Dallas, TX (United States). May 1993. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-930511–15: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93014103. Source: OSTI; NTIS; INIS; GPO Dep.

The Superconducting Super Collider (SSC) will be the first proton machine in which synchrotron radiation significantly affects the cryogenic system and the beam tube vacuum. Synchrotron radiation represents the single largest heat load on the 4 K single-phase helium. It also provides a mechanism by which hydrogen can be desorbed from the beam tube wall, gradually worsening the vacuum. Insertion of a perforated and heated liner into the cold beam tube, together with a strip of cryosorber, effectively creates a distributed cryopump. Such an arrangement is an attractive solution to possible vacuum problems, provided it does not increase the heat load on the single-phase helium. In this paper, the primary mechanisms of heat transfer from an 90 K liner are considered, and the results of measurements on heat conduction through prototypical mechanical supports are presented.

24413 (SSCL-Preprint–333) **The Accelerator Systems String Test Program.** Kraushaar, P. Superconducting Super Collider Lab., Dallas, TX (United States). May 1993. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-930511–19: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93014260. Source: OSTI; NTIS; INIS; GPO Dep.

The Accelerator Systems String Test (ASST) complex is located at the N15 site in Ellis County Texas. The complex was initially constructed to demonstrate the operation of a standard half-cell of the Collider machine lattice using prototypical superconducting magnets. The ASST half cell consisted of five 50 mm aperture dipoles, one 40-mm aperture quadrupole and three spool pieces. This demonstration was a Congressionally-mandated milestone for the Superconducting Super Collider Laboratory (SSCL) and was scheduled for completion by October 1, 1992. The milestone test (Run 1) was completed with the successful powering ofthe half cell to 6500 A in mid-August 1992.

24414 (SSCL-Preprint–342) **Quench and quench protection for the SSC collider correctors.** He, A. Superconducting Super Collider Lab., Dallas, TX (United States). May 1993. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-930511–10: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93014070. Source: OSTI; NTIS; INIS; GPO Dep.

The quench voltage, especially the turn-to-turn voltage, and the maximal temperature rise due to the quench in 50-mm-aperture Superconducting Super Collider correctors are calculated for various currents. The calculation shows a lower copper-to-superconductor ratio gives a lower quench voltage and a lower temperature rise as the result of much higher heat capacity of the superconducting material and lower copperresistivity at lower temperature. It also shows that when the copper to superconductor ratio is 2.2 to 1, each individually powered magnet is self-protected, and for the series of 24 correctors that are poweredtogether in the collider, a parallel 2-O resistor on each magnet will provide needed protection. The energy loss on these resistors during powering up is less than 5% of the energy stored in the magnet at the operating current.

24415 (SSCL-Preprint–349) **Modification of the short straight sections of the high energy booster of the SSC.** Li, M.; Johnson, D.; Kocur, P.; Schailey, R.; Servranckx; Talman, R.; Yan, Y.; York, R.; Yarba, V. Superconducting Super Collider Lab., Dallas, TX (United States). May 1993. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-930511–55: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93014139. Source: OSTI; NTIS; INIS; GPO Dep.

The tracking analysis with the High Energy Booster (HEB) of the Superconducting Super Collider (SSC) indicated that the machine dynamic aperture for the current lattice (Rev 0 lattice) was limited by the quadrupoles in the short straight sections. A new lattice, Rev 1, with modified short straight sections was proposed. The results of tracking the two lattices up to 5 $\times$ 10^5 turns (20 seconds at the injection energy) with various random seeds are presented in this paper. The new lattice has increased dynamic aperture from

~7 mm to ~8 mm, increases the abort kicker effectiveness, and eliminates one family (length) of main quadrupoles. The code DIMAD was used for matching the new short straight sections to the ring. The code TEAPOT was used for the short term tracking and to create a machine file, zfile, which could in turn be used to generate a one-turn map with the ZLIB for fast long-term tracking using a symplectic one-turn map tracking program ZIMAPTRK.

24416 (SSCL-Preprint–356) **Broadband higher-order mode (HOM) damper for SSC LEB ferrite-tuned cavity.** Walling, L.; Hulsey, G.; Grimm, T. Superconducting Super Collider Lab., Dallas, TX (United States). May 1993. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-930511–21: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93014273. Source: OSTI; NTIS; INIS; GPO Dep.

This paper reports results of using High-Frequency Structure Simulator (HFSS) to design a Smythe-type broadband longitudinal HOM damper for the SSCL low energy booster (LEB) ferrite-tuned cavity. The damper is designed to have a shunt impedance varying from less than 1 kohm between 100–200 MHz to about 3 kohm at 1 GHz. Above 1 GHz, the ferrite should effectively damp all HOM.

24417 (SSCL-Preprint–358) **Consequences of kicker failure during HEB to collider injection and possible mitigation.** Soundranayagam, R.; Drozhdin, A.I.; Mokhov, N.V.; Parker, B.; Schailey, R.; Wang, F. Superconducting Super Collider Lab., Dallas, TX (United States). May 1993. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-930511–109: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93014066. Source: OSTI; NTIS; INIS; GPO Dep.

In this paper we discuss the three failure modes, namely, single kicker failure, two kickers failure and timing error between the extraction and injection kickers. We propose possible means of protecting the accelerator components.

24418 (SSCL-Preprint–361) **RF system analyses for the SSC collider rings.** Rogers, J.; Coleman, P.; Schaffer, G.; Wallace, J.; Wang, X.; Zhao, Y. Superconducting Super Collider Lab., Dallas, TX (United States). May 1993. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-930511–64: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93014082. Source: OSTI; NTIS; INIS; GPO Dep.

The Collider RF system is required to accelerate and store a 70 mA DC proton beam from 2 TeV to 20 TeV. Various approaches have been studied as possible ways to accomplish this task. These include systemsbased on five-cell normal conducting cavities, single-cell normal conducting cavities, and single-cell superconducting cavities. This paper outlines the physics requirements that the system must meet and presents comparisons of the expected performance of various systems. Transient beam loading, injection error, power requirements, coupled bunch mode instabilities, etc. are considered.

24419 (SSCL-Preprint–363) **An experimental and analytical study of a buoyancy driven cooling system for a particle accelerator.** Campbell, B.; Ranganathan, R. Superconducting Super Collider Lab., Dallas, TX (United States). May 1993. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-930511–23: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93014274. Source: OSTI; NTIS; INIS; GPO Dep.

A buoyancy driven closed-loop cooling system that transports the heat generated in a particle accelerator to the ambient has been evaluated both through experiments performed earlier and analysis techniques developed elsewhere. Excellent comparisons between measurements and calculations have been obtained. The model illustrates the feasibility (from a heat transfer viewpoint) of such a cooling system for a particle accelerator.

24420 (SSCL-Preprint–366) **Effect of betatron motion on the spetum flux in superslow extraction at the SSC.** Newberger, B. (Texas Univ., Austin, TX (United States)); Ellison, J.; Shih, H. Superconducting Super Collider Lab., Dallas, TX (United States). May 1993. 4p. Sponsored by USDOE, Washington, DC (United States); Texas National Research Lab. Commission, De Soto, TX (United States). DOE Contract AC35-89ER40486. Grant RGFY 9234. (CONF-930511–20: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93014257. Source: OSTI; NTIS; INIS; GPO Dep.

A scheme for the superslow extraction of protons from SSC rings for high energy test beam or precision fixed-target B physics is currently being investigated. The flux onto the extraction septum (a curved Si crystal) is to be general diffusion produced by noise injected into the RF system. The extraction rate depends on both the diffusion of the closed orbit (due to dispersion at the crystal) and the horizontal betatron amplitude of the diffusing protons. The diffusion of the closed orbit has previously been described by the one-dimension longitudinal diffusion theory of Dome and Krinsky and Wang. In this paper, we extend this theory to include effect of the betatron motion. Comparisons with Monte Carlo tracking simulations are made.

24421 (SSCL-Preprint–371) **Physics requirements of commissioning diagnostics for SSCL linac.** Hurd, J.W. (Superconducting Super Collider Lab., Dallas, TX (United States)); Arbique, G.M.; Crist, C.E.; Guy, F.W.; Haworth, M.; Leifeste, G.T.; Saadatmand, K.; Krogh, M.; Mcginnis, K.; Stittsworth, D.; Vandeusen, A.; Wright, S. Superconducting Super Collider Lab., Dallas, TX (United States). May 1993. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-930511–5: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93014105. Source: OSTI; NTIS; INIS; GPO Dep.

Commissioning diagnostics are described in terms of the beam physics requirements of the SSCL linac. Commissioning diagnostics include current monitors, beam position monitors, spectrometer, foil scattering experiment, wire scanners, Faraday cups, and bunch shape monitors. Two DOE integrated contractors, the Superconducting Super Collider Laboratory and Allied Signal, Kansas City Plant, are developing the commissioning diagnostics. The need to measure bright, short linac beam pulses requires special design considerations. High density harps and collectors with up to 50 wires per cm and 128 wires total, and fast, 3.5-MHz amplifiers have been developed. The diagnostics will be first used and tested during beam commissioning of the RFQ.

24422 (SSCL-Preprint–373) **Beam diagnostic layout requirements for SSCL linac.** Hurd, J.; Guy, F.; Jamieson, G.; Raparia, D.; Saadatmand, K. Superconducting Super Collider Lab., Dallas, TX (United States). May 1993. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-930511–12: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93014072. Source: OSTI; NTIS; INIS; GPO Dep.

A basic set of diagnostics is needed to commission, tune, and monitor the operation of the SSCL linac. This set of diagnostics has been relined in the final stages of design of the linac. Planned diagnostics include current monitors, Faraday cups, beam loss monitors, beam position monitors, wire scanners, absorber-collector phase scan units, slit and collector emittance measurement units, and longitudinal bunch shape monitors. The diagnostics are described and their placement along the linac is given. The use of the diagnostics for tuning the linac is described. The first set of diagnostics will be installed with the RFQ, with additional diagnostics installed with each linac section.

24423 (SSCL-Preprint–376) **Effective stress of the SSC 80-K synchrotron radiation liner in a quenching dipole magnet.** Leung, K.K.; Shu, Q.S.; Yu, K.; Zbasnik, J. Superconducting Super Collider Lab., Dallas, TX (United States). May 1993. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-930511–11: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93014071. Source: OSTI; NTIS; INIS; GPO Dep.

This paper describes the effective stress on a proposed SSC beam tube. The new issue for the Collider compared to earlier accelerators is the combination of synchrotron radiation with the 4.2-K bore tube of the superconducting magnets. One design option is to use a liner within a bore tube to remove the radiated

power and the accompanying photodesorbed gas that impair the beam tube vacuum. Design of the SSC 80-K synchrotron radiation liner requires vacuum luminosity lifetime = 150 hours and liner electrical conductivity, σ*t > 2E5 Ω-1. The bimetallic liner tube is subjected to cool down and eddy current loads. The liner tube is a two-shell laminate with Nitronic-40 steel for strength and a copper inner layer for low impedance to the image currents induced by the circulating protons. High electrical conductivity of the copper layer is essential for minimizing the power losses. Perforated holes are used to remove the photodesorbed gases for vacuum maintenance. The tube is cooled by 80-K lines. Structural design of the liner is not covered by the ASME code. The life of the liner involves structural integrity and keeping the copper laminate within yield stress limits to maintain the high surface finish for minimizing the power losses. The copper layer stress governs the structural design of the liner. The liner tube analysis is a three-dimensional non-linear stress problem. Thermal transient cool down stress is not considered in this analysis because of the floating support design of the liner. This analysis will address the axial thermal stress, non-axisymmetrical eddy current loads, dynamic and non-linear material effect on the liner that have not been considered in publications on beam tube structural analyses.

24424 (SSCL-Preprint–378) **Photodesorption experiments on SSC collider beam tube configurations.** Maslennikov, I. (Superconducting Super Collider Lab., Dallas, TX (United States)); Turner, W.; Anashin, V.; Malyshev, O.; Osipov, V.; Nazmov, V.; Pindyurin, V.; Salimov, A.; Foerster, C.; Lanni, C. Superconducting Super Collider Lab., Dallas, TX (United States); AN SSSR, Novosibirsk (Russian Federation). Inst. Yadernoj Fiziki. May 1993. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-930511–29: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93014107. Source: OSTI; NTIS; INIS; GPO Dep.

Experimental measurements of photodesorption coefficients of H_2, CH_4, CO and CO_2 are being done to obtain data necessary to predict the vacuum performance of the Collider. Experiments have been done or are planned for warm tubes (i.e. room temperature), cold tubes (i.e. 4.2 K) and liner configurations (i.e. 4.2 K, 20 K and 80 K). Two synchrotron radiation beamlines have been constructed on the VEPP-2M storage ring at BINP, Russia. The photon critical energy is 284 eV, as in the SSC Collider, angle of incidence is 10 mrad. To date approximately fifteen warm beam tubes have been tested, including elecrodeposited Cu, high purity bulk Cu and Nitronic 40 SS, several cleaning procedures, with and without in-situ baking and with and without magnetic field. The maximum integrated photon dose was achieved was $2{\cdot}10^{22}$ photons/m on the high intensity beamline. Several experiments have been done on the VUV ring at BNL to check a subset of the BINP data and to extend the integrated photon flux up to 10^{23} photons/m, or 100 days of SSC operation. The data from the warm experiments will be used to evaluate the best tubes to be used in the more time consuming cold experiments.

24425 (UCRL-JC–111229) **Improved focus solenoid design for linear induction accelerators.** Zentler, J.M. (Lawrence Livermore National Lab., CA (United States)); Van Maren, R.D.; Nexsen, W.E. Lawrence Livermore National Lab., CA (United States). Aug 1992. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9208109–79: 16. international LINAC conference, Ottawa (Canada), 23-28 Aug 1992). Order Number DE93011895. Source: OSTI; NTIS; INIS; GPO Dep.

Our FXR linear induction accelerator produces a 2 KA, 17 MeV electron beam of 60 ns duration. The beam is focused on a tantalum target to produce x-rays for radiography. The FWHM spot size of the focused beam is currently 2.2 mm. We strive to reduce the spot size by 30% by improving the field characteristics of focusing solenoids housed in each of 50 induction cells along the beamline. Tilts in the magnetic axis of the existing solenoids range up to 12 mrad (0.7 degrees). We are building new solenoid assemblies which include ferromagnetic homogenizer rings. These dramatically reduce field errors. A field tilt of under 0.5 mrad has been achieved. Mechanical alignment of the rings is critical. We developed a novel construction method in which the rings are wound with 4 mil thick Si-Fe ribbon into grooves on an aluminum cylinder. The cylinder then becomes the winding mandrel for the focus solenoids. This forms a more accurate and compact assembly than the standard practice of pressing individual solid rings onto a tube.

24426 (UCRL-JC–112275) **Critical issues for vacuum systems in B factories.** Barletta, W.A. (Lawrence Livermore National Lab., CA (United States)). Lawrence Livermore National Lab., CA (United States). Nov 1992. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9204126–20: B factories: state of the art in accelerators, detectors, and physics, Stanford, CA (United States), 6-10 Apr 1992). Order Number DE93013831. Source: OSTI; NTIS; GPO Dep.

B factories with sufficient luminosity for the study of CP violation will require beams with characteristics more demanding on technical sub-systems than those of previous $e^+ - e^{minus}$ colliders. In particular, the consequent system requirements on the vacuum chamber and pumping systems will require a vigorous R&D program to resolve critical technical issues and to validate design approaches.

24427 (UCRL-JC–112342) **Analysis of beam loading in electrostatic columns.** Caporaso, G.J.; Barnard, J.J. Lawrence Livermore National Lab., CA (United States). 12 May 1993. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-930511–68: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93013851. Source: OSTI; NTIS; INIS; GPO Dep.

A lumped element circuit model is derived which accounts for both electric and magnetic coupling of the beam to the electrodes and drive circuitry of an electrostatic column. A modified one dimensional Poisson equation which incorporates two dimensional effects is discussed. An effective capacitance between the beam and the column electrodes which affects the electric coupling is estimated. Simple analytic cases which treat electric and magnetic coupling separately are solved and compared against a numerical simulation. Scaling laws are given for the magnitude of the beam loading.

4304 Storage Rings

24428 (BNL–48792) **Impedance of the NSLS prototype small-gap undulator vacuum chamber.** Bane, K. (Stanford Linear Accelerator Center, Menlo Park, CA (United States)); Krinsky, S. Brookhaven National Lab., Upton, NY (United States). Mar 1993. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. Order Number DE93012530. Source: OSTI; NTIS; GPO Dep.

Insertion device performance is limited by the minimum magnet gap allowed by storage ring beam dynamics. In this note, we analyze the impedance of the vacuum chamber for the prototype small-gap undulator being built for the NSLS X-Ray ring, and discuss the consequent beam instability thresholds.

24429 (INIS-RU–343, pp. 10-15) **Physical design of electron cooling of the AN Ukrainian SSR IYal accelerating-storage complex.** Val'kov, A.E. (AN Ukrainskoj SSR, Kiev (Ukraine). Inst. Yadernykh Issledovanij); Dolinskij, A.V.; Zhmendak, A.V.; Pavlov, S.N.; Papash, A.I.; Dikanskij, N.S.; Kudelajnen, V.I.; Pestrikov, D.V.; Sukhina, B.N. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (Russian Federation). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i; AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1991. [80p.] (In Russian). In *Nuclear-physical researches (Theory and experiment): Scientific-technical collection.* Order Number DE93626131. Source: OSTI; NTIS (US Sales Only); INIS.

General performance data of the accelerating-storage complex (ASC) with electron cooling are presented and physical aspects of its construction are considered; the ring is being built in the Institute of Nuclear Research of the Ukrainian Academy of Sciences. It is shown that an electron cooling system with charge compensated

electron beam should be used for expanding experimental capability of the designed ASC. 13 refs.; 5 tabs.

24430 (LA-UR–93-1866) **Status of the PSR improvement program.** Macek, R.J.; Fitzgerald, D.H.; Hoehn, M.V.; Ryder, R.D.; York, R.L. Los Alamos National Lab., NM (United States). [1993]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930511–41: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93014479. Source: OSTI; NTIS; INIS; GPO Dep.

A program of improvements to increase intensity and improve reliability of the Los Alamos Proton Storage Ring (PSR) has been under way for several years. Reduction of stored beam loss rates by a factor of 4.6 since 1987 through exploitation of H^0 injection has allowed the average intensity to increase by a factor of two to 75μA. Reliability of the PSR and associated beam delivery systems has been improved by extensive rework of numerous subsystems. Radiation protection has been improved by additional shielding of Line D and extensive use of relatively fail-safe radiation detectors incorporated into an improved radiation security system.

44 INSTRUMENTATION

24431 (DOE/CE/40777–10) **On-machine sensors to measure paper mechanical properties.** Hall, M.S.; Brodeur, B.H.; Jackson, T.G. Institute of Paper Science and Technology, Atlanta, GA (United States). [1991]. 75p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-86CE40777. (CONF-9111305–1: Department of Energy industry advanced sensors technical conference, Cincinnati, OH (United States), 11 Nov 1991). Order Number DE93010636. Source: OSTI; NTIS; GPO Dep.

The purpose of the program is to develop sensors capable of measuring the velocity of ultrasound in the thickness and in-plane directions of paper while the paper is moving at line speed on the paper machine. These measurements would provide a nondestructive characterization of the mechanical properties of paper, allowing continuous monitoring of product quality as well as providing data for controlling the papermaking process.

4401 Radiation Instrumentation

Refer also to citation(s) 23053, 23101, 23104, 23185, 23526, 23893, 23987, 23988, 24012, 24075, 24119, 24275, 24276, 24707, 24709, 24788, 24865, 24899, 24976, 24998, 25009, 25010, 25011, 25035, 25036, 25081, 25154, 25324

24432 (BNL–52321) **Proceedings of the symposium on RHIC detector R&D.** Makdisi, Y.; Stevens, A.J. (eds.). Brookhaven National Lab., Upton, NY (United States). [1991]. 246p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-9110232–: Symposium on Relativistic Heavy Ion Collider (RHIC) detector R&D, Upton, NY (United States), 10-11 Oct 1991). Order Number DE93010855. Source: OSTI; NTIS; INIS; GPO Dep.

This report contains papers on the following topics: Development of Analog Memories for RHIC Detector Front-end Electronic Systems; Monolithic Circuit Development for RHIC at Oak Ridge National Laboratory; Highly Integrated Electronics for the STAR TPC; Monolithic Readout Circuits for RHIC; New Methods for Trigger Electronics Development; Neurocomputing methods for Pattern Recognition in Nuclear Physics; The Development of a Silicon Multiplicity Detector System; A Transition Radiation Detector for RHIC Featuring Accurate.

24433 (CIEMAT–699) **Thin, conductive, pyrrolyc film production for radioactive sources backings.** Rodriguez, L.; Los Arcos, J.M. Centro de Investigaciones Energeticas, Medioambientales y Tecnologicas (CIEMAT), Madrid (Spain). 1993. 29p. (In Spanish). Order Number DE93796617. Source: OSTI; NTIS.

A procedure for electropolymerization of pyrrole has been set up in order to produce thin (> 15 μ g/cm^2) homogeneous (thickness variation <2%) films, with no need for additional metallization to be used as backings of radioactive sources, having 10-0,4 kω/sample, for 35-70 μg/cm^2. The experimental equipment, reagent and procedure utilized is described as well as the characterization pyrrolic films produced.

24434 (CONF-920791–, pp. 3, Paper 29) **Improvements in inductively coupled plasma - mass spectrometry for elemental and isotopic analysis.** Houk, R.S. (Iowa State Univ., Ames (US)); Warren, A.R.; Pang, Homing. USDOE Assistant Secretary for Environmental Restoration and Waste Management, Washington, DC (United States). Jul 1992. From Information exchange meeting on characterization sensors and monitoring technologies; Dallas, TX (United States); 15-16 Jul 1992. In *Proceedings of the information exchange meeting on characterization, sensors, and monitoring technologies.* 261p. Order Number DE93005318. Source: OSTI; NTIS.

A new type of ICP-MS device that contains two separate quadrupole mass analyzers. The objective is to improve the precision and sensitivity with which either stable or radioactive elements may be determined in any type of sample. Representative applications pertinent to waste remediation will be pursued.

24435 (CONF-920837–45) **Preliminary results from the CMD-2 detector.** Khazin, B.I.; Akhmetshin, R.R.; Aksenov, G.A.; Anashkin, E.V.; Aulchenko, V.M.; Baibusinov, B.O.; Banzarov, V.S.; Barkov, L.M.; Baru, S.E.; Bashtovoi, N.S.; Bondar, A.E.; Eidelman, S.I.; Fedorenko, V.E.; Fedotovitch, G.V.; Grebeniuk, A.A.; Grigoriev, D.N.;Pittsburgh Univ., PA (United States). Dept. of Physics and Astronomy. [1992]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-91ER40646. From ICHEP-26: 26th International Union of Pure and Applied Physics (IUPAP) conference on high energy physics; Dallas, TX (United States); 6-12 Aug 1992. Order Number DE93013491. Source: OSTI; NTIS; INIS; GPO Dep.

A new general-purpose detector CMD-2 (calorimetric magnetic detector has started experiments at the upgraded e^+e^- collider VEPP-2M (collider for electron-positron beams) at Novosibirsk. During early runs an integrated luminosity of about 400 inverse nanobarns has been collected in the center of mass energy range 400–1030 MeV.

24436 (DOE/ER/40660–1) **GEM muon tracking R and D: Progress report, August 1992–July 1993.** Lau, K.; Mayes, B.; Pyrlik, J.; Weinstein, R. Houston Univ., TX (United States). Inst. for Beam Particle Dynamics. Apr 1993. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG05-91ER40660. Order Number DE93014097. Source: OSTI; NTIS; INIS; GPO Dep.

The suitability of open-profile CSCs for the GEM muon system was evaluated by constructing a small (0.5 m x 1.0 m) prototype and testing it with cosmic ray muons. The measured spatial resolution surpassed the GEM requirement of 75 μm. The test results were compared with Monte Carlo simulations; good agreement was found. Studies of the timing properties of the prototype have been started.

24437 (FNAL/C–93/043-E) **A scintillating fiber detector for the D0 upgrade.** Wayne, M. (Notre Dame Univ., IN (United States). Dept. of Physics). D0 Collaboration. Fermi National Accelerator Lab., Batavia, IL (United States); Notre Dame Univ., IN (United States). Dept. of Physics. Mar 1993. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03000. (CONF-921122–49: Meeting of the Division of Particles and Fields of the American Physical Society, Batavia, IL (United States), 10-14 Nov 1992). Order Number DE93011658. Source: OSTI; NTIS; INIS; GPO Dep.

In the Step 1 version of the D0 upgrade, the inner vertex chamber will be replaced by a system of silicon microstrips surrounded by a scintillating fiber detector. Details of the detector design and status of R&D and construction programs for the detector are presented. Progress on the upcoming large-scale cosmic ray test at Fermilab is also reported.

24438 (FNAL/C–93/053-E) **Upgraded Dν calorimeter electronics for short Tevatron bunch space and the effect of pile-up on the W mass measurement.** Lokos, S. For the DO Collaboration. Fermi National Accelerator Lab., Batavia, IL (United

States). Nov 1992. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03000. (CONF-921122–56: Meeting of the Division of Particles and Fields of the American Physical Society, Batavia, IL (United States), 10-14 Nov 1992). Order Number DE93013566. Source: OSTI; NTIS; INIS; GPO Dep.

The high luminosity and short bunch spacing time of the upgraded Tevatron force the calorimeter to replace a significant part of the present electronics. The W mass measurement was used to study the pile-up effects.

24439 (IFVE-OEF–90-88) **Manufacture of mirrors with high reflectivity in the VUV-region.** Buzulutskov, A.F.; Vanyushkin, Yu.V.; Kostrikov, M.E.; Chernetsov, M.I. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov (Russian Federation). Inst. Fiziki Vysokikh Ehnergij. 1990. [7p.] (In Russian). Order Number DE93626355. Source: OSTI; NTIS (US Sales Only); INIS.

The technique for manufacturing mirrors with high reflectivity in the VUV-region is described. The mirrors are designed to be used in the RICH-detector. 6 refs.; 6 figs.

24440 (INDC(NDS)–213/GM3, pp. 67) **Semiconductor detectors for the calibration of the targets from fissile radionuclides.** Loshaev, S.L. (Radievyj Inst., Leningrad (Russian Federation)); Soloviev, S.M. International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Oct 1988. (CONF-8809159–: 14. world conference of the International Nuclear Target Development Society (INTDS): heavy-ion targets and related phenomena, Darmstadt (Germany), 5-9 Sep 1988). In *The influence of target and sample properties on nuclear data measurements: Summary report of the IAEA advisory group meeting in co-operation with the International Nuclear Target Development Society (INTDS), held in Darmstadt, Germany, 5-9 September 1988.* [74p.] Order Number DE93626092. Source: OSTI; NTIS (US Sales Only); INIS.

The description of the set of semiconductor detectors with a large area and complicated shapes used in the Radium Institute for the calibration of alpha activities of targets from fissile radionuclides including low radioactive targets and targets with complex configurations will be presented. (author). Abstract only.

24441 (JINR–5-51-91, pp. 23-37) **Scintillation forward spectrometer of the SPHERE setup.** Anisimov, Yu.S.; Afanas'ev, S.V.; Bondarev, V.K. Joint Inst. for Nuclear Research, Dubna (Russian Federation). 1991. [64p.] (In Russian). In *JINR rapid communications: Collection.* Order Number DE93626358. Source: OSTI; NTIS (US Sales Only); INIS.

The construction of the forward spectrometer for the 4π SPHERE setup to study multiple production of particles in nucleus-nucleus interactions is described. The measured parameters of the spectrometer detectors are presented. 7 refs.; 14 figs.; 1 tab.

24442 (JINR-E–1-92-101) **The compensation of longitudinal energy leakage in the short absorption calorimeters.** Gavrishchuk, O.P. (and others); Eremeev, R.V.; Kadykov, M.G. Joint Inst. for Nuclear Research, Dubna (Russian Federation). 1992. [6p.] Order Number DE93626356. Source: OSTI; NTIS (US Sales Only); INIS.

The influence of longitudinal nuclear cascade fluctuations and (transparence)on hadron sampling-calorimeter energy resolution was under consideration on this paper. The possibility to improve the energy resolution with the compensation of shower leakage in longitudinal direction was achieved by optimization of the shifter attenuation length in the light pipe. 6 refs.; 3 figs.

24443 (JINR-R–13-92-91) **Streamer chamber of the GIBS spectrometer.** Aksinenko, V.D. (and others); Vardenga, G.L.; Glagoleva, N.S. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of High Energy. 1992. [10p.] (In Russian). Order Number DE93626357. Source: OSTI; NTIS (US Sales Only); INIS.

The streamer chamber of the GIBS magnetic spectrometer constructed on the 2m streamer chamber SKM-200 basis is described. The streamer chamber is used in the beams of accelerated nuclei at the JINR synchrophasotron. 9 refs.; 7 figs.

24444 (JINR-R–15-92-50) **Main characteristics of scintillation phoswich-detectors for the 4π-experimental setup PHOBOS.** Fomichev, A.S. (and others); Ortlepp, H.G.; Penionzhkevich, Yu.Eh. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of Nuclear Reactions. 1992. [10p.] (In Russian). Order Number DE93626386. Source: OSTI; NTIS (US Sales Only); INIS.

The main characteristics of a scintillation part for the 4π-multidetector PHOBOS are described. The choice of the scintillator material and type of photomultiplier are discussed and the description of the mechanical and electronic design is given. 12 refs.; 8 figs.

24445 (LA–12413) **Superlattice electroabsorption radiation detector.** Cooke, B.J. Los Alamos National Lab., NM (United States). Jun 1993. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. Order Number DE93014019. Source: OSTI; NTIS; INIS; GPO Dep.

This paper provides a preliminary investigation of a new class of superlattice electroabsorption radiation detectors that employ direct optical modulation for high-speed, two-dimensional (2-D), high-resolution imaging. Applications for the detector include nuclear radiation measurements, tactical guidance and detection (laser radar), inertial fusion plasma studies, and satellite-based sensors. Initial calculations discussed in this paper indicate that a 1.5-μm (GaAlAs) multi-quantum-well (MQW) Fabry-Perot detector can respond directly to radiation of energies 1 eV to 10 KeV, and indirectly (with scattering targets) up through gamma, with 2-D sample rates on the order of 20 ps.

24446 (LA-SUB–93-100) **HELGA HPGe detectors: Final report.** Reintiz, K. (EG and G Washington Analytical Services Center, Inc., Suitland, MD (United States)). Los Alamos National Lab., NM (United States); EG and G Washington Analytical Services Center, Inc., Suitland, MD (United States). 31 May 1987. 34p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. Order Number DE93009411. Source: OSTI; NTIS; GPO Dep.

An improvement in the present HELGA project, could be obtained, if the remaining units purchased could be N-type detectors, since the dead layer on these units is negligible. Some improvement in sensitivity could be obtained with the N-type units, because of the virtual elimination of the dead layer, but it would require an additional power, supply and some addition to and modification of the existing electronics. During the course of the contract an experiment, was suggested to verify the analysis and to introduce the application variables one by one. In this manner, these variables could be better, understood and controlled. The experiment would use an N-type slab-like detector and the beam would be collimated toward its central portion. In this manner, the effect of the dead layer, detector, geometry and non-uniform electric field would be eliminated. Penetrating gamma rays should be used so that their, range is a substantial (about 3/4) fraction of the detector thickness arid the count rate should be low to minimize dead time corrections. This experiment would eliminate many of the corrections that need to be introduced into the calculations to bring the experiment into a seasonable agreement.

24447 (LA-UR–93-1162) **Silicon-based elementary particle tracking system: Materials science and mechanical engineering design.** Miller, W.O.; Gamble, M.T.; Thompson, T.C.; Hanlon, J.A. Los Alamos National Lab., NM (United States). [1993]. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930758–1: 9. international conference on composite materials, Madrid (Spain), 12-16 Jul 1993). Order Number DE93012630. Source: OSTI; NTIS; GPO Dep.

Research and development of the mechanical, cooling, and structural design aspects of a silicon detector-based elementary particle tracking system has been performed. Achieving stringent system precision, stability, and mass requirements necessitated the use of graphite fiber-reinforced cyanate-ester (C-E) resins. Mechanical test results of the effects of butane, ionizing radiation, and a combination of both on the mechanical properties of these materials are presented, as well as progress on developing compression molding of an ultralightweight graphite composite ring structure and TV holography-based noninvasive evaluation.

24448 (LA-UR–93-1389) **A new chopper spectrometer for neutron Brillouin scattering and low-angle neutron inelastic scattering: PHAROS (Phase 1).** Robinson, R.A.; Nutter, M.; Ricketts, R.L.; Larson, E.; Sandoval, J.P.; Lysaght, P.; Olivier, B.J. Los Alamos National Lab., NM (United States). [1993]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9305177–1: 12. International collaboration of advanced neutron sources meeting (ICANS), Abingdon (United Kingdom), 24-28 May 1993). Order Number DE93012678. Source: OSTI; NTIS; INIS; GPO Dep.

Phase I of PHAROS, the new chopper spectrometer at LANSCE, is described in detail. The main components are a water moderator, a 60-Hz double-bladed T-zero chopper, a 600Hz magnetic-bearing Fermi chopper, a 6m-long vacuum vessel with thin aluminium-alloy vacuum window and a 1.2m^2 array of linear position-sensitive detectors.

24449 (LBL–33295) **Experimental efforts and results in finding new heavy scintillators.** Derenzo, S.E.; Moses, W.W. Lawrence Berkeley Lab., CA (United States). Sep 1992. 11p. Sponsored by USDOE, Washington, DC (United States); Department of Health and Human Services, Washington, DC (United States). DOE Contract AC03-76SF00098. Grant R01-CA48002. (CONF-9209253–4: Crystal 2000 international workshop on heavy scintillators for scientific and industrial applications, Chamonix (France), 22-26 Sep 1992). Order Number DE93010406. Source: OSTI; NTIS; GPO Dep.

New heavy scintillators are being discovered with increasing frequency. In recent years NaI(Tl) (with its high light output and energy resolution) has been joined by BGO (with its high stopping power), BaF_2 (with its excellent timing resolution), and CeF_3 (with its speed and short Moliere radius). More than 10 potentially useful scintillators have been under development in the past five years, such as $PbSO_4$ and Lu_2SiO_5(Ce). We tabulate the characteristics of these and other scintillators, including wavelength, luminous efficiency, decay time, and initial intensity. We describe a search strategy and the prospects for finding the "ideal" heavy scintillator, which would combine the light output of NaI(Tl) and CsI(Tl), the stopping power of BGO, and the speed of BaF_2 and ZnO(Ga).

24450 (ORNL/FTR–4183) **[Travel to Switzerland to attend a meeting of the WA93 Collaboration]: Foreign trip report, January 5–12, 1992.** Young, G.R. Oak Ridge National Lab., TN (United States). 24 Jan 1992. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93011089. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The traveler attended the WA93 collaboration meeting held at CERN, Geneva, Switzerland, on January 6–11, 1992. Other local attendees included Terry Awes (ORNL) and Xiaochun He (University of Tennessee). Representatives from GSI, Lund, Munster, Utrecht, KVI, Kurchatov, and Geneva were also in attendance. The spokesman, Hans Gutbrod, was ill. The meeting was, thus, run in Gutbrod's absence by Michel Martin, head of the University of Geneva group, and by Rainer Santo, head of the University of Munster group. Copies of transparencies shown plus minutes taken are available.

24451 (ORNL/FTR–4277) **[Travel to Switzerland and France to discuss current scintillation crystal technology]: Foreign trip report, May 5–9, 1992.** Heck, J.L. Jr.; Rennich, M.J. Oak Ridge National Lab., TN (United States). 9 Jun 1992. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93011073. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Technical discussions were held about the experience gained by CERN in procuring bismuth germanate (BGO) scintillation crystals from the Shanghai Institute of Ceramics (SIC) in China. These discussions primarily focused on the processes, facilities and equipment used to grow and mechanically process scintillation crystals. Discussions were not limited to BGO, but also included the future possibility of SIC producing cerium fluoride crystals for CERN as well as barium fluoride crystals for the GEM detector to be used at the SSC.

24452 (PTB-Dos–21) **Dose measurement techniques for high-energy photon and electron radiation. Proceedings.** Hohlfeld, K.; Roos, M. (eds.). Physikalisch-Technische Bundesanstalt, Braunschweig (Germany). Dosimetrie. Aug 1992. 127p. (In German). (CONF-9111318–: 95. PTB seminar 'Dose measurement techniques for high-energy photon and electron radiation', Braunschweig (Germany), 11-12 Nov 1991). Order Number DE93796871. Source: OSTI; NTIS (US Sales Only); INIS.

By law the Federal Institute of Physics and Technology (PTB) has been assigned the tasks of representing, preserving and passing on dose units. The analogous continuation of these tasks consists in improving, at the user level, dosimetry techniques in radiation therapy for the benefit of patients. The PTB had an essential share in working out the scientific foundations of dosimetry for high-energy radiation, and the corresponding DIN standards were established with the PTB playing a promiment part. The seminar aimed at presenting the measuring techniques fixed in the new DIN standard 6800 part 2 'Dose measurement techniques according to the probe method - ionization dosimetry', to discuss their physical background and practical implications resulting from them. (orig.).

24453 (PTB-Dos–21, pp. 1-12) **Representation and preservation of the water-energy dose unit.** Roos, M. (Physikalisch-Technische Bundesanstalt, Braunschweig (Germany)). Physikalisch-Technische Bundesanstalt, Braunschweig (Germany). Dosimetrie. Aug 1992. (In German). (CONF-9111318–: 95. PTB seminar 'Dose measurement techniques for high-energy photon and electron radiation', Braunschweig (Germany), 11-12 Nov 1991). In *Dose measurement techniques for high-energy photon and electron radiation. Proceedings.* 127p. Order Number DE93796871. Source: OSTI; NTIS (US Sales Only); INIS.

To represent the water-energy dose unit for high-energy photon and electron radiation, the chemical procedure was expanded into a fundamental measuring technique, and established as a primary normal measuring device of the Federal Republic of Germany. In addition, the water-energy calorimetric dosemeter, a definition measuring method, is being developed which seems to be destined for making a contribution, over the longer term, to reducing measuring uncertainties in dosimetry. (orig./DG).

24454 (PTB-Dos–21, pp. 13-23) **Passing on of the water-energy dose unit - the concept of the standard DIN 6800 part 2.** Hohlfeld, K. Physikalisch-Technische Bundesanstalt, Braunschweig (Germany). Dosimetrie. Aug 1992. (In German). (CONF-9111318–: 95. PTB seminar 'Dose measurement techniques for high-energy photon and electron radiation', Braunschweig (Germany), 11-12 Nov 1991). In *Dose measurement techniques for high-energy photon and electron radiation. Proceedings.* 127p. Order Number DE93796871. Source: OSTI; NTIS (US Sales Only); INIS.

In order to be able to perform a reliable measurement with a maximum of accuracy by means of an available measuring instrument, a prescribed measuring technique has to be used. The measuring technique for ionization chamber dosimetry is fixed in the standard DIN 6800 part 2 (1990). The steps necessary for representation and preservation of the unit are described in detail, above all with regard to the effects they have on the measuring accuracy of dose determination. (orig./DG).

24455 (PTB-Dos–21, pp. 24-45) **The radiation field in the water phantom.** Grosswendt, B. (Physikalisch-Technische Bundesanstalt, Braunschweig (Germany)); Roos, M. Physikalisch-Technische Bundesanstalt, Braunschweig (Germany). Dosimetrie. Aug 1992. (In German). (CONF-9111318–: 95. PTB seminar 'Dose measurement techniques for high-energy photon and electron radiation', Braunschweig (Germany), 11-12 Nov 1991). In *Dose measurement techniques for high-energy photon and electron radiation. Proceedings.* 127p. Order Number DE93796871. Source: OSTI; NTIS (US Sales Only); INIS.

After analysing the possibilities of simulating radiation transport of electrons and photons in matter, several basic principles of Monte Carlo transport calculations are introduced and applied to the dosimetry of radiation fields in water phantoms. Priority is given to the determination of stopping power ratios and energy parameters to characterize clinical radiation fields since they are of fundamental importance for dosimetry in radiation therapy. (orig.).

24456 (PTB-Dos–21, pp. 46-60) **General corrections in ionization dosimetry.** Derikum, K. (Physikalisch-Technische Bundesanstalt, Braunschweig (Germany)). Physikalisch-Technische Bundesanstalt, Braunschweig (Germany). Dosimetrie. Aug 1992. (In German). (CONF-9111318–: 95. PTB seminar 'Dose measurement techniques for high-energy photon and electron radiation', Braunschweig (Germany), 11-12 Nov 1991). In *Dose measurement techniques for high-energy photon and electron radiation. Proceedings.* 127p. Order Number DE93796871. Source: OSTI; NTIS (US Sales Only); INIS.

Factor k corrects the effect of influence quantities which in dose measurement deviate from reference conditions during calibration. Such correction factors apply both to electron and photon radiation. The following paragraphs explain the respective physical effects on which they are based. It is stated how corrections have to be determined and which value ranges are to be expected. For ionization chambers which were studied at the linear accelerator of the PTB, experimentally determined correction factors are indicated for typical measuring conditions. (orig./DG).

24457 (PTB-Dos–21, pp. 61-66) **The correction factor k_Q for radiation quality of high-energy photon radiation.** Krauss, A. (Physikalisch-Technische Bundesanstalt, Braunschweig (Germany)). Physikalisch-Technische Bundesanstalt, Braunschweig (Germany). Dosimetrie. Aug 1992. (In German). (CONF-9111318–: 95. PTB seminar 'Dose measurement techniques for high-energy photon and electron radiation', Braunschweig (Germany), 11-12 Nov 1991). In *Dose measurement techniques for high-energy photon and electron radiation. Proceedings.* 127p. Order Number DE93796871. Source: OSTI; NTIS (US Sales Only); INIS.

The correction factor k_Q for indicating the water-energy dose, takes into consideration the change in the response of the ionization chamber as a function of the radiation quality of incident photon radiation. The reference radiation quality is that of ^{60}Co gamma radiation in the water phantom. The correction factor k_Q is determined. (orig./DG).

24458 (PTB-Dos–21, pp. 67-79) **Comparative measurements using chemical dosemeters, and extension of compulsory calibration to include high energies.** Schneider, M.K.H. (Physikalisch-Technische Bundesanstalt, Braunschweig (Germany)). Physikalisch-Technische Bundesanstalt, Braunschweig (Germany). Dosimetrie. Aug 1992. (In German). (CONF-9111318–: 95. PTB seminar 'Dose measurement techniques for high-energy photon and electron radiation', Braunschweig (Germany), 11-12 Nov 1991). In *Dose measurement techniques for high-energy photon and electron radiation. Proceedings.* 127p. Order Number DE93796871. Source: OSTI; NTIS (US Sales Only); INIS.

The extension of compulsory calibration of therapy dosemeters to include high-energy radiation is indicated. Extended compulsory calibration prescribes the use of dosemeters calibrated for cobalt gamma radiation, and obligatory participation in comparative measurements. Comparative measurements as a contribution to quality assurance in clinical dosimetry have proved successful, and their feasibility is shown by a measuring program using chemical dosemeters. (orig./DG).

24459 (PTB-Dos–21, pp. 80-86) **Future development of the demands on therapy dosemeters with ionization chambers.** Schneider, U. (Physikalisch-Technische Bundesanstalt, Braunschweig (Germany)). Physikalisch-Technische Bundesanstalt, Braunschweig (Germany). Dosimetrie. Aug 1992. (In German). (CONF-9111318–: 95. PTB seminar 'Dose measurement techniques for high-energy photon and electron radiation', Braunschweig (Germany), 11-12 Nov 1991). In *Dose measurement techniques for high-energy photon and electron radiation. Proceedings.* 127p. Order Number DE93796871. Source: OSTI; NTIS (US Sales Only); INIS.

Only little will change with the introduction of the European internal market with regard to the demands on ionization chamber dosemeters used in radiotherapy, provided that the harmonized standard is aligned with IEC publication 731. Type licences for domestic calibration will be replaced by European Communities licences. (orig.).

24460 (PTB-Dos–21, pp. 87-96) **The correction factor k_E for electron radiation quality.** Christ, G. (Tuebingen Univ. (Germany). Medizinische Physik). Physikalisch-Technische Bundesanstalt, Braunschweig (Germany). Dosimetrie. Aug 1992. (In German). (CONF-9111318–: 95. PTB seminar 'Dose measurement techniques for high-energy photon and electron radiation', Braunschweig (Germany), 11-12 Nov 1991). In *Dose measurement techniques for high-energy photon and electron radiation. Proceedings.* 127p. Order Number DE93796871. Source: OSTI; NTIS (US Sales Only); INIS.

In ionization dosimetry, correction factors take into account the deviations from conditions during measurements on the one hand and conditions of calibration on the other hand. One of these correction factors is k_E which considers the influence of electron radiation quality. Two aspects are covered, namely the different stopping power ratio of water to air with regard to the interesting electron radiation compared to ^{60}Co radiation, and the different field disturbances under measurement and calibration conditions. The importance of correction factor k_E and various ways to determine this quantity are shown. (orig./DG).

24461 (PTB-Dos–21, pp. 97-111) **Dosimetry from the point of view of clinical physicists - practical implementation and problems.** Scheffler, A. (Klinikum Steglitz, Berlin (Germany). Abt. Strahlentherapie). Physikalisch-Technische Bundesanstalt, Braunschweig (Germany). Dosimetrie. Aug 1992. (In German). (CONF-9111318–: 95. PTB seminar 'Dose measurement techniques for high-energy photon and electron radiation', Braunschweig (Germany), 11-12 Nov 1991). In *Dose measurement techniques for high-energy photon and electron radiation. Proceedings.* 127p. Order Number DE93796871. Source: OSTI; NTIS (US Sales Only); INIS.

Dosimetry of a linear accelerator is understood to be the acquisition of basic data for therapy planning, and of initial values for constance tests of the calibration of dose monitors. The basic data for therapy planning are divided into 'point data' and 'dose distributions'. Point data are dose values on the axis of the useful beam at selected points, for instance at the reference depth or the depth of the maximum dose on the axis of the useful beam. The representations concentrate on the description of point data and their acquisition. (orig./DG).

24462 (SSCL-Preprint–258) **System-level description of the SDC detector.** Wells, N. Superconducting Super Collider Lab., Dallas, TX (United States). Apr 1993. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-930537–17: 5. annual international industrial symposium on the Super Collider and exhibition, San Francisco, CA (United States), 6-8 May 1993). Order Number DE93014080. Source: OSTI; NTIS; INIS; GPO Dep.

The detector being designed by the Solenoidal Detector Collaboration (SDC) is an eight with 8.5 million sensor elements. The positions of these elements must be known to less than one millimeter accuracy to meet the physics requirements. However, this 75-million pound experimental device could settle up to 20 millimeters and the entire detector, as well as its components, must be moveable to align with the proton beam and to accommodate detector and floor deflections. Interesting engineering challenges are presented as the detector is designed. The management challenge of integrating the work of about 1000 physicists and engineers at institutions around the world is also significant. The coordination process is being facilitated by the publishing of a reference book for detector designers, the SDC Detector Parameters Book that contains the latest design information. It was used as the source of detector data contained in this paper (unless otherwise indicated). This paper describes some of the systems issues that are being faced as the detector is designed. After the detector is described, the foundation requirements are reviewed and the method of keeping the detector aligned with the proton beam described. A discussion of detector operations and maintenance completes the paper.

24463 (UCRL-ID–112223) **Gamma-insensitive optical focal plane array.** Kruger, H. Lawrence Livermore National Lab., CA

(United States). Oct 1992. 69p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE93013100. Source: OSTI; NTIS; GPO Dep.

Two types of optical focal plane array concepts are proposed which use semitransparent photocathodes and gas avalanche multiplication to count an optical photon or a gamma as submicrosecond pulses with a charge that can be adjusted to be as large as 106 electrons. Avalanche diameters are sufficiently small to allow use of pixel sizes of tens of microns. Currently available photocathode materials permit operation at ultraviolet/visible wavelengths with ~10–20% quantum efficiency and in the near-infrared with ~0.1–0.3% quantum efficiency. The dark current of these photocathodes is sufficiently low so that they can be operated at room temperature. The weight of these gas avalanche focal plane designs is small and negligible compared to that required for data processing. The first concept, using a quartz cathode plate, is a relatively simple mechanical design. It detects a gamma mainly through the Cerenkov photons radiated in the quartz by the high-energy end of the gamma-produced Compton electron spectrum. It can operate in a high gamma flux; however, it has little capability to discriminate between optical photon and gamma counts. The second concept uses scintillating fiberoptic cathode and anode plates to detect all the gamma-produced electrons. It is a more complicated design; however, it is inherently capable of discriminating between optical photon and gamma events on the basis of pulse height and pixel count pattern. It can operate in a gamma flux of 10^{10} to 10^{11} gammas/cm^2/sec if built with scintillating glass fibers. Use of plastic scintillation fibers increases the tolerable gamma flux to ~10^{12}–10^{13} gammas/cm^2/sec, but makes the mechanical design of the gas avalanche focal plane array more difficult. Prototype gas avalanche focal plane arrays need to be built and tested to verify feasibility of this optical sensor concept.

24464 (UCRL-ID–112587) **Metal-semiconductor, composite radiation detectors: FY92 progress report.** Orvis, W.J.; Yee, J.H.; Fuess, D. Lawrence Livermore National Lab., CA (United States). Dec 1992. 23p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE93013313. Source: OSTI; NTIS; INIS; GPO Dep.

In 1989, Naruse and Hatayama of Toshiba published a design for an increased efficiency x-ray detector. The design increased the efficiency of a semiconductor detector by interspersing layers of high-z metal within it. Semiconductors such as silicon make good, high-resolution radiation detectors, but they have low efficiency because they are low-z materials (z = 14). High-z metals, on the other hand, are good absorbers of high-energy photons. By interspersing high-z metal layers with semiconductor layers, Naruse and Hatayama combined the high absorption efficiency of the high-z metals with the good detection capabilities of a semiconductor. This project is an attempt to use the same design to produce a high-efficiency, room temperature gamma ray detector. By their nature, gamma rays require thicker metal layers to efficiently absorb them. These thicker layers change the behavior of the detector by reducing the resolution, compared to a solid state detector, and shifting the photopeak by a predictable amount. During the last year, the authors have procured and tested a commercial device with operating characteristics similar to those of a single layer of the composite device. They have modeled the radiation transport in a multi-layered device, to verify the initial calculations of layer thickness and composition. They have modeled the electrostatic field in different device designs to locate and remove high-field regions that can cause device breakdown. They have fabricated 14 single layer prototypes.

24465 (UCRL-JC–107306) **A fiber optic array for continuous energy coverage in a gamma ray spectrometer.** Cochran, C.W. (Lawrence Livermore National Lab., CA (United States)); Kammeraad, J.E.; Sale, K.E.; Lown, J.G.; Robson, J.D.; Marroquin, J.P.; Sanchez, A. Jr. Lawrence Livermore National Lab., CA (United States). Jul 1992. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-920792–54: Society of Photo-Optical Instrumentation Engineers (SPIE) international symposium on optical applied science and engineering, San Diego, CA (United States), 19-24 Jul 1992). Order Number DE93012489. Source: OSTI; NTIS; GPO Dep.

Optical fibers are being used to obtain full coverage over a range of energies in a multi-channel, time-resolved gamma ray spectrometer. Gamma rays are incident upon a beryllium foil 60cm from the entrance port of a Sm-Co magnet. Compton electrons from the foil are focussed according to their energy onto quartz optical fibers arrayed in close-packed configuration behind a low-Z vacuum window at the focal plane. Cerenkov radiation produced inside each of the fibers propagates down the fiber which is brought out of the magnet. Fibers are grouped into preselected energy bins corresponding to streak record channel assignments. The light from the fibers in an energy bin are combined into one signal and then transmitted to a streak camera with a specified number of channels. This unique optical fiber array serves both as the detector and as a means to define energy bins of our choosing for a streak camera recording system.

24466 (UCRL-JC–113380) **Resolution for Lanczos and Paige-Saunders inverses in tomography.** Berryman, J.G. Lawrence Livermore National Lab., CA (United States). Mar 1993. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9305169–1: Stanford exploration project program review, Stanford, CA (United States), 17-21 May 1993). Order Number DE93012312. Source: OSTI; NTIS; GPO Dep.

Methods have been developed for computing both the model and data resolution matrices for iterative inverses such as those produced by the Lanczos and Paige-Saunders (LSQR) schemes for constructing linear inverses.

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Refer also to citation(s) 25165

24467 (JINR–5-51-91, pp. 38-41) **Radiation hardness tests of a scintillating fiber calorimeter module.** Afanas'ev, S.V. (and others); Anisimov, Yu.S.; Kolesnikov, V.I. Joint Inst. for Nuclear Research, Dubna (Russian Federation). 1991. [64p.] In *JINR rapid communications: Collection.* Order Number DE93626358. Source: OSTI; NTIS (US Sales Only); INIS.

Scintillating fiber based electromagnetic calorimeter module has been tested on radiation hardness. Energy resolution worsened to 18.2% immediately after irradiation to a a dose 1.25 Mrad comparing with its initial value 5.4% while light output decreased by a factor of 2.75. Further degradation of the performance as well as partial recovering after rest was observed up to the dose of 7.5 Mrad. 2 refs.; 3 figs.

4404 Well Logging Instrumentation

Refer also to citation(s) 22852

4406 Optical Instrumentation

Refer also to citation(s) 23222, 23223, 23894, 24054, 24145, 24267, 24290, 24463, 24641, 24944

24468 (ANL/MSD/CP–78008) **Prism-film coupling in anisotropic planar waveguides of epitaxial (101) rutile thin films.** Foster, C.M.; Chan, S.K.; Chang, H.L.M.; Chiarello, R.P.; Lam, D.J. Argonne National Lab., IL (United States). Materials Science Div. Apr 1993. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-930405–4: Spring meeting of the Materials Research Society, San Francisco, CA (United States), 12-16 Apr 1993). Order Number DE93012912. Source: OSTI; NTIS; GPO Dep.

We report optical waveguiding in single-crystal, epitaxial (101) oriented rutile (TiO_2) thin films grown on (1120) sapphire (α-Al_2O_3) substrates using the MOCVD technique. The propagation-constants for asymmetric planar waveguides composed of an anisotropic dielectric media applicable to these films are derived. Modifications to the prism-film coupling theory for this anisotropic case are also discussed. By application of this model to (101) oriented rutile thin films, we directly obtain values of the ordinary and extraordinary refractive indexes, n_o and n_e, of the rutile thin films as well as film

thicknesses. We obtain typical values of the refractive indexes (n_o=2.5701±0.0005; n_e=2.934±0.001) near to those for bulk rutile single crystals indicating the exceptional quality of these films.

24469 (DOE/FTR–93013019) **Travel to Australia to participate in the the 24th international symposium on combustion: Foreign trip report, June 29–July 16, 1992.** Ottesen, D.K. Sandia National Labs., Livermore, CA (United States). 14 Aug 1992. 29p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. Order Number DE93013019. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report summarizes the Proceedings of the 24th International Symposium on Combustion held in Sydney, Australia, July 5–10, 1992, and describes the current research activities in several important optical diagnostics groups in Australia including: (1) at the BHP Co. Newcastle Research Laboratories, the Sensing Technology R & D Division; (2) the Centre for Lasers and Applications within the School of Chemistry at Macquarie University; (3) the Laser Applications Group at the CSIRO, Division of Mineral and Process Engineering; and (4) the Minerals Research Laboratory at the CSIRO, Division of Coal and Energy Technology.

24470 (DOE/PC/92521–T31) **Development of an on-line image analysis for assessment of pyrite liberation: Technical report, December 1, 1992–February 28, 1993.** Yen, M.S.C. (Southern Illinois Univ., Carbondale, IL (United States)); Chu, P.T.C.; Ho, K. Illinois Dept. of Energy and Natural Resources, Springfield, IL (United States). 1993. 24p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC22-92PC92521. Order Number DE93013650. Source: OSTI; NTIS; GPO Dep.

An automation procedure based on the principles of image processing is proposed to perform the analysis of pyrite/minerals liberation of coal. To make the automated image analysis system possible, a data base of the light reflectance characteristics of different coal constituents must be established. Characterization of coal images through the analysis of their histogram was conducted. In general, it was found that the distinction of coal particles or particle groups may be accomplished by determining the gray levels of zero pixel or by taking average gray level of each particle. In particular, when the gray level averaging is applied, the spread of gray levels of a given maceral becomes smaller. In other words, the spread in gray level among different maceral group becomes larger. This has led to a distinct boundary between different material group of coal. Two computer programs based on these findings are being developed. The implementation of these criteria will cover most of the coal samples that are previously analyzed. Consideration of special cases will require additional data analysis of histogram.

24471 (LBL–33982) **New a-Si:H photo-detectors for long-term charge storage.** Lee, H.; Cho, G.; Drewery, J.S.; Hong, W.S.; Jing, T.; Kaplan, S.N.; Mireshghi, A.; Perez-Mendez, V.; Wildermuth, D. Lawrence Berkeley Lab., CA (United States). Apr 1993. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. (CONF-930405–9: Spring meeting of the Materials Research Society, San Francisco, CA (United States), 12-16 Apr 1993). Order Number DE93013909. Source: OSTI; NTIS; INIS; GPO Dep.

Using the high light absorption properties of amorphous silicon, we developed a new device configuration that can detect photons and store the induced charges for relatively long time. This device, coupled to a scintillator such as CsI(Tl) in an array form, could be used as a scintillation camera, or for long-term photo-detection such as radionuclide labeled chromatography. The detector has a simple sandwich structure consisting of a scintillator followed by a top metal layer, p-i-n layers of hydrogenated amorphous silicon (a-Si:H), a second metal layer, a thin insulating layer and a bottom metal layer. The electron-hole pairs generated in the i-layer by the interaction with the incident light will be separated by the imposed electric field and be stored in the central metal-insulator interface. Readout will be done by switching the external bias to ground after the storage time, which depends on the needs for the specific application. Prototype devices were fabricated and tested. The performances of the devices were analyzed in connection with the storage time and the background signal produced by the thermally generated charges.

24472 (SAND–93-0539C) **Application of normalized gray-scale correlation.** Yee, M. (Sandia National Labs., Albuquerque, NM (United States)); Dickey, F.M.; Stalker, K.T.; Kast, B.A. Sandia National Labs., Albuquerque, NM (United States). [1993]. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-930445–12: Society of Photo-Optical Instrumentation Engineers (SPIE) OE/aerospace science and sensing meeting, Orlando, FL (United States), 11-16 Apr 1993). Order Number DE93013765. Source: OSTI; NTIS; GPO Dep.

Real-time gray-scale correlation in the spatial domain has been demonstrated previously using an acousto-optical (AO) correlator. This work demonstrates normalized gray-scale correlation as implemented on an AO correlator system capable of operating at real-time video rates. Motivation for using normalized gray-scale correlation is presented. The normalized correlation algorithm as implemented on the AO correlator is detailed. The entire real-time AO correlator system is described, including the electronic support hardware and the user interface. Since normalization requires a division operation, system numerical precision issues are addressed. Test results obtained in non-real time experiments are presented.

24473 (UCRL-JC–109342) **A Fabry–Perot microinterferometer for visible wavelengths.** Raley, N.F.; Ciarlo, D.R.; Koo, J.C.; Beiriger, W.J.; Trujillo, J.T.; Yu, C.M.; Loomis, G.M.; Chow, R. Lawrence Livermore National Lab., CA (United States). Apr 1992. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9206172–3: Solid state sensor and actuator workshop, Hilton Head Island, SC (United States), 21-25 Jun 1992). Order Number DE93012478. Source: OSTI; NTIS; GPO Dep.

We report here on our efforts to develop a silicon-based microinterferometer for optical applications in the visible spectral region using micromachining fabrication techniques. The interferometer is formed by two parallel dielectric mirrors supported on membranes which are electrostatically deflected for wavelength control. A simplified two-wafer fabrication process has been designed and investigated. We have obtained 250 nm membrane deflection for an applied voltage of 100 V. Hafnium dioxide-silicon dioxide dielectric mirrors have been fabricated on membrane supports and also free-standing with high reflectivity and low stress. Optical transmission of fixed mirrors yield 1.6 nm spectral resolution at 450 nm wavelength with significant signal and selectivity. Anticipated applications include microinstrument spectroscopy systems for atomic absorption, ellipsometry, imaging, optical fiber communications, and general spectrophotometer uses as well as accelerometry.

24474 (UCRL-JC–109348) **Long wavelength characterization of internal quantum efficiency in LT–GaAs MSM photodiodes.** Morse, J.D.; Mariella, R.P. Jr. Lawrence Livermore National Lab., CA (United States). Dec 1991. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-911202–89: Annual fall meeting of the Materials Research Society, Boston, MA (United States), 2-6 Dec 1991). Order Number DE93012487. Source: OSTI; NTIS; GPO Dep.

Metal-Semiconductor-Metal (MSM) photodiodes fabricated from low temperature all grown GaAs by molecular beam epitaxy have been characterized for wavelengths extending out to 1.5μm. External quantum efficiencies on the order of 0.5 % have been measured for subbandgap wavelengths, which translates to internal quantum efficiencies of 2–4 % for the interdigitated electrode structure with 1μm finger spacing and width. Although the effective lifetime of the LT-GaAs has been determined to be <1ps, an MSM photodiode response of ~10ps full width at half maximum was measured by correlation techniques at 820 nm wavelength, and a system limited response of 3GHz was measured at 1.3 μm wavelength. These experimental results win be described in detail.

24475 (UCRL-JC–111388) **Damage threshold study of ion beam sputtered coatings for a visible high-repetition laser at LLNL.** Stolz, C.J.; Taylor, J.R. Lawrence Livermore National Lab., CA (United States). Oct 1992. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-921047–4: Symposium on optical materials for high-power lasers, Boulder, CO (United States), 28-30 Oct 1992). Order Number DE93013430. Source: OSTI; NTIS; GPO Dep.

Ion Beam Sputtered (IBS) coatings offer some distinct advantages over electron beam deposited (e-beam) coatings, namely environmental stability and extremely low total losses. Initial IBS coatings had excessive stress and low laser damage thresholds. For these reasons, a study was initiated to examine potential laser damage thresholds and stress of IBS coatings. A material study was conducted of IBS coatings produced in industry, and a variety of design techniques were explored to increase laser damage thresholds. A post annealing process and backside coatings were developed to reduce the coating stress.

24476 (UCRL-JC–112602) **A fast frame rate 512 × 512 CCD digital camera system.** Conder, A.; Mitchell, R.; Schulte, H. Lawrence Livermore National Lab., CA (United States). Jan 1993. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-930163–2: IS&T/SPIE symposium on electronic imaging science and technology, San Jose, CA (United States), 31 Jan - 5 feb 1993). Order Number DE93013048. Source: OSTI; NTIS; GPO Dep.

This paper details the performance and shows images obtained from a 512 x 512 CCD camera capable of recording 400 digitized frames per second. A brief description of the data acquisition hardware andimage analysis software is also included.

4407 Geophysical and Meteorological Instrumentation

Refer also to citation(s) 22780, 23001, 24586, 24708

4408 Miscellaneous Instrumentation

Refer also to citation(s) 24066, 24086, 24389, 24507, 24514, 24516, 24581, 24710, 24712, 24792

24477 (ANL/FC/CP–77793) **Remote real time x-ray examination of fuel elements in a hot cell environment.** Yapuncich, F.L. Argonne National Lab., Idaho Falls, ID (United States). [1993]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-930403–44: 5. topical meeting on robotics and remote systems, Knoxville, TN (United States), 26-29 Apr 1993). Order Number DE93009975. Source: OSTI; NTIS; INIS; GPO Dep.

This report discusses the Remote Real Time X-ray System which will allow for detailed examination of fuel elements. This task will be accomplished in a highly radioactive hot cell environment. Two remote handling systems win be utilized at the examination station. One handling system will transfer the fuel element to and from the shielded x-ray system. A second handling system will allow for vertical and rotational inspection of the fuel elements. The process win include removing a single nuclear fuel element from a element fabrication magazine(EFM), positioning the fuel element within the shielding envelope of the x-ray system and transferring the fuel element from the station manipulator to the x-ray system manipulator, performing the x-ray inspection, and then transferring the fuel element to either the element storage magazine(ESM) or a reject bin.

24478 (CONF-920791–, pp. 6, Paper 32) **Portable acoustic wave sensors for voltaile organic compounds.** Frye, G.C. (Sandia National Labs., Albuquerque, NM (US)); Cernosek, R.W.; Martin, S.J. USDOE Assistant Secretary for Environmental Restoration and Waste Management, Washington, DC (United States). Jul 1992. From Information exchange meeting on characterization sensors and monitoring technologies; Dallas, TX (United States); 15-16 Jul 1992. In *Proceedings of the information exchange meeting on characterization, sensors, and monitoring technologies.* 261p. Order Number DE93005318. Source: OSTI; NTIS.

Portable acoustic wave sensor (PAWS) systems are being developed for real-time, on-line monitoring of volatile organic compounds (VOCs). These systems are built around surface acoustic wave (SAW) devices coated with viscoelastic polymers. Two independent responses of the SAW sensor, wave velocity and wave attenuation, are measured to provide information about the chemical species sorbed by the coating. Rapid, reversible detection of gas phase volatile organics has been demonstrated for process monitoring and waste minimization in environmentally conscious manufacturing (ECM) applications and for documenting contaminant concentrations in remediation efforts.

24479 (DOE/PC/90181–T8) **Particulate Flow Research Laboratory quarterly progress report, October 1, 1992–December 31, 1992.** Rosato, A.D.; Dave, R.N.; Fischer, I.S. New Jersey Inst. of Tech., Newark, NJ (United States). Particulate Flow Research Lab. 1992. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-91PC90181. Order Number DE93013071. Source: OSTI; NTIS; GPO Dep.

Only minor changes have been made to the one-transmitter model code since the last report. Most changes were small and improved either code legibility or speed. Several redundant calculations were removed from the inner loop of the program. We performed a series of experiments to determine how well the single-transmitter model matches the actual measured voltages, and how the differences between the predicted and actual behavior of the voltage in the antennas affects the inverse transformation. These experiments used many different linear trajectories and several different sets of calibration points. For most known trajectories we were able to reproduce the path from the measured voltages with an accuracy of no worse than two inches for the worst points. (Most points are substantially more accurate). We have, however, identified two problem regions. The model encounters difficulty when the transmitter crosses the plane of an antenna or when the transmitter is almost parallel to an antenna and is moving nearly parallel to that antenna.When the transmitter crosses an antenna the measured voltage is significantly higher than the model would predict. Currently we're attributing this to small asymmetries and extra wiring in the test transmitter that only becomes significant on a scale of a couple of inches. These will not be present in the actual transmitter. If the new, more symmetric transmitter still has this problem we have worked out an iterative scheme for selectively choosing which antennas to use to calculate the position of the sphere at a given place.

24480 (JINR-R–13-91-424) **A high-precision direct current measuring device over a kiloampere range.** Voevodin, M.A.; Gusakov, Yu.V.; Korukov, N.A.; Sajfulin, Sh.Z.; Yalovoj, I.N. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of High Energy. 1991. [4p.] (In Russian). Order Number DE93626409. Source: OSTI; NTIS (US Sales Only); INIS.

In power supply systems a need arises for wide-band loading currents monitors with a not galvanic contact from a control circuit. The measuring device is a reaction self-regulation circuit with a compensation of the value of the measured parameter. The measuring device may find extensive application in measurements of supply currents magnets and accelerator lenses. 5 refs.; 2 figs.

24481 (ORNL/FTR–4215) **[Travel by ORNL personnel to Japan concerning testing of a field emission gun-transmission electron microscope and for discussion of electron holography]: Foreign trip report, March 13–20, 1992.** Allard, L.F. Oak Ridge National Lab., TN (United States). 6 Apr 1992. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93011108. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The traveler visited the Hitachi Instruments Division (HID) factory in Katsuta, Japan, to test the HF-2000 FEG electron microscope prior to shipment to ORNL. A visit was also paid to the HARL in Hatoyama, Japan, to discuss electron holography and the requirements for a digital imaging system for high-resolution electron holography.

24482 Multiple-frequency acoustic wave devices for chemical sensing and materials characterization in both gas and liquid phase. Martin, S.J.; Ricco, A.J. To Dept. of Energy. 1991. Filed date 24 May 1991. USA patent application 7-705,408. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. Order Number DE93011996. Source: OSTI; NTIS; GPO Dep.

This invention consists of a chemical sensor that includes two or more pairs of interdigital electrodes having different periodicities. Each pair is comprised of a first electrode and a second electrode.

The electrodes are patterned on a surface of a piezoelectric substrate. Each pair of electrodes may launch and receive various acoustic waves (AW), including a surface acoustic wave (SAW), and may also launch and receive several acoustic plate modes (APMs). The frequencies associated with each are functions of the transducer periodicity as well as the velocity of the particular AW in the chosen substrate material. An AW interaction region exists between each pair of electrodes. Circuitry is used to launch, receive, and monitor the propagation characteristics of the AWs and may be configured in an intermittent measurement fashion or in a continuous measurement fashion. Perturbations to the AW velocity and attenuation are recorded at several frequencies and provide the sensor response.

24483 (RFP–4693) **An automated gas expansion system.** Abercrombie, K. EG and G Rocky Flats, Inc., Golden, CO (United States). [1993]. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC34-90DP62349. (CONF-930780–1: National conference of standards laboratories, Albuquerque, NM (United States), 25 Jul 1993). Order Number DE93012704. Source: OSTI; NTIS; GPO Dep.

The Metrology Laboratory at the Rocky Flats Plant has constructed a new Vacuum Gauge Calibration System based on gas expansion. The system is used to calibrate vacuum pressure gauges between 1 mTorr and 1000 mTorr. The paper discusses an overview of the system including layout, software, testing and performance.

24484 (SAND–92-2623C) **Micromachined chemical sensor with integrated microelectronics.** Smith, J.; Sniegowski, J.; Koehler, D.; Ricco, T.; Martin, S.; McWhorter, P. Sandia National Labs., Albuquerque, NM (United States). [1992]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-9305110–1: Expo 93, Oak Ridge, TN (United States), May 1993). Order Number DE93013761. Source: OSTI; NTIS; INIS; GPO Dep.

With today's continued emphasis on environmental safety and health issues, a resurgence of interest has developed in the area of chemical sensors. These sensors would typically be used to monitor contamination hazards such as underground storage tanks or to assess previous contamination at waste disposal sites. Human exposure to chemical hazards can also be monitored. Additionally, these sensors can be used as part of a manufacturing process control loop. One type of sensor suitable for gas phase monitoring of chemicals is the quartz resonator or quartz crystal microbalance (QCM) sensor. In this type of sensor, a thickness shear mode (TSM) quartz resonator is coated with a film that interacts with the chemical species of interest. Changes in the mass and elasticity of this film are reflected as changes in the resonant properties of the device. Therefore, the presence of the species of interest can be detected by monitoring the frequency of an oscillator based on the resonance of the quartz. These QCM sensors compete with surface acoustic wave (SAW) devices as a means for monitoring gas phase species. SAW devices are typically more sensitive to small amounts of a species, but the instrumentation associated with a SAW device is an order of magnitude more expensive than the instrumentation associated with a TSM wave resonator since the SAW devices operate in the 100's of MHz frequency regime while quartz resonators operate in the 5–25 MHz regime. We are working to improve the sensitivity of the QCM sensor by increasing the frequency of the device to 25 MHz (compared to the typical 5 MHz crystal) and by increasing the frequency stability of the system to an ultimate goal of 0.1 Hz. The 25 MHz QCM has already been achieved and once the stability goal is achieved, the QCM will have the same sensitivity as a SAW device.

24485 (SAND–92-8003) **Dynamic response of a transducer mounted at one end of an acoustical cavity.** Benedetti, G.A. Sandia National Labs., Livermore, CA (United States). Apr 1993. 67p. Sponsored by USDOE, Washington, DC (United States); Department of Defense, Washington, DC (United States). DOE Contract AC04-76DR00789. Order Number DE93012837. Source: OSTI; NTIS; GPO Dep.

The dynamic response of a transducer mounted at one end of a one-dimensional acoustical cavity is determined. The cavity is filled with a compressible isentropic fluid, and the fluid at the open end of thecavity (i.e., the boundary at $x = 0$) is subjected to an axial displacement specified with respect to time. At the other end of the cavity the transducer is represented as a mass, spring, and damper system. Consequently, the boundary condition at $x = \ell$ is also time dependent. The general solution to the boundary value problem is obtained as well as the steady state solution for harmonic excitation. Since the steady state response for harmonic excitation is of particular interest, an analytical or closed form solution is obtained for the displacement and e and useful algebraic expression is obtained for pressure responsefunctions. In addition, a simple and useful algebraic expression is obtained for the steady state pressure-frequency response function for harmonic excitation. An approximate solution is also obtained for the dynamic response of a transducer mounted at one end of a two-diameter or stepped-recessed cavity. Stepped-recessed pressure transducer cavities, which may be grease-filled, are suitable for measuring quasi-static pressures in solid propellant guns and regenerative liquid propellant guns (RLPGs), provided the frequencies contained in the quasi-static pressure pulse are low relative to the fundamental frequency for the empty stepped cavity.

24486 (UCRL-ID–110108) **Sensing technology for pressure, flow, viscosity and moisture content monitoring in autoclave environments.** Beadles, J.R.; Spellman, G.P. Lawrence Livermore National Lab., CA (United States). Mar 1992. 24p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE93012388. Source: OSTI; NTIS; GPO Dep.

This report is an evaluation of sensor technology for continuously determining pressure, flow, viscosity, and moisture content of the resin in fiber composite laminates that are being cured in an autoclave. An effort has been made to identify the individuals and firms active in research and manufacture of such sensors. Monitoring technologies of interest include dielectric, fiber optic, strain gage, capacitive, ultrasonic, piezoelectric, nuclear magnetic resonance, resistance change, vibration, tracer/fluorescent particle analysis, and anemometer. The focus is on sensors that produce real-time data; techniques that rely on indirect correlations and modeling for estimates of effects are discussed only briefly.

24487 (UCRL-JC–109818) **Four-GHz analog data acquisition system using high-frequency guided-wave modulators.** Roeske, F.; Haigh, R.E.; Hugenberg, K.F.; Lowry, M.E.; Nelson, D.C. Lawrence Livermore National Lab., CA (United States). Aug 1992. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9209184–8: The International Society for Optical Engineering (SPIE) meeting, Boston, MA (United States), 8-11 Sep 1992). Order Number DE93013041. Source: OSTI; NTIS; GPO Dep.

High-frequency modulators have been used to record very fast analog voltage pulses in the Nuclear Test Program at LLNL. A system consisting of 810 nm laser diode carrier sources, 7 GHz Y-branched, balanced bridge modulators (YBBM), a kilometer of single-mode optical fiber and a streak camera recorder has been successfully fielded. The total system −3db bandwidth is 4 GHz with a slow roll-off allowing the recoverable data capabilities of the system to approach 10 GHz. This system has provided us with a diagnostic tool that allows us to resolve high-frequency structure in our signals which has been calculated but never measured because of limitations in the resolution of previous measuring systems. A description of the system will be given with particular emphasis given to the YBBM modulator characteristics and performance. Fast pulse data recorded by the system will be shown and an indication of the accuracy with which the pulse can be reproduced will be provided. We expect this system to be a valuable tool that will be used regularly to study the physics of materials at extremely high temperatures and densities. Plans for upgrading the system to have a −3db bandwidth of 7–8 GHz will also be discussed.

24488 (UCRL-JC–110274) **Needs for super-smooth surfaces.** Saito, T.T. Lawrence Livermore National Lab., CA (United States). May 1992. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9206297–2: International symposium on optical fabric testing and surface evaluation, Tokyo (Japan), 6 Jun 1992). Order Number DE93012482. Source: OSTI; NTIS; GPO Dep.

Understanding the needs for super smooth optics give insights for optical fabricators tasked to produce them. These needs include substrates for metrology and a host of X-ray applications. In addition to some grazing angle of incidence optics,, normal incidence optics with multilayer stacks have been recently produced. These optics have very demanding finish requirements. Lacquer and flow polishing have produced some interesting surfaces.

45 MILITARY TECHNOLOGY, WEAPONRY, AND NATIONAL DEFENSE

Refer also to citation(s) 23086, 23139, 23155, 23718, 23754, 24177, 24729, 24732, 24733, 24734, 24735, 24736, 24737, 24876, 24912, 24917, 25299

24489 (CONF-9302106–Summ.) **Interagency Advanced Power Group, Electrical Working Group meeting minutes.** Horizon Data Corp., Reston, VA (United States). Power Information Center. [1993]. 18p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC01-90CE90053. From Interagency Advanced Power Group (IAPG) electrical working group meeting; Palo Alto, CA (United States); 10-12 Feb 1993. Order Number DE93010899. Source: OSTI; NTIS; GPO Dep.

These minutes review the Electrical Working Group February 1993 meeting. An introduction by Gene Schwarze, Electrical Working Group Chairman, are followed by presentations from the superconductivity panel, the power conditioning panel and the pulse power panel. Closing comments and action items conclude the meeting.

24490 (LA-SUB–93-173) **USSOUTHCOM Counterdrug Modeling and Simulation System (CMASS) report: Final report.** Los Alamos National Lab., NM (United States); GPS Technologies, Inc. (United States). 31 Mar 1993. 149p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract W-7405-ENG-36. Order Number DE93012895. Source: OSTI; NTIS; GPO Dep.

USSOUTHCOM, in conjunction with Los Alamos National Labs (LANL), is in its second year of development of CMASS (Counterdrug Modeling and Simulation System). The purpose of this project is to provide an opportunity for the multiple agencies involved in the war on drugs to cooperate to simulate the various activities that must be coordinated and performed to meet the mission. LANL is providing development of computer-based support data and models to assist in gaming and strategies. Other contractors provide technology and program management support. Section 1 of this report provides observations and recommendations based on: numerous conversations with representatives from the various participating agencies and services; observation of two iterations of wargames held at the Joint Warfare Center, Hurlburt Field, FL; and reading and reviewing briefings and literature as provided by the program management office and by various agencies. Section 2 compares and contrasts two delivery media currently available in the Department of Defense.

24491 (ORNL/TM–12330) **Automatic ammunition identification technology test report for the Datamatrix and Code 49 symbologies: Ammunition Logistics Program.** Weil, B.S. Oak Ridge National Lab., TN (United States). Mar 1993. 68p. Sponsored by USDOE, Washington, DC (United States); Department of Defense, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93012511. Source: OSTI; NTIS (US Sales Only); GPO Dep.

A series of tests was conducted to evaluate the two-dimensional bar codes called Datamatrix and Code 49. Two-dimensional bar codes are being considered for use in ammunition logistics systems and automated reloading equipment. For this reason, the purpose of these evaluations was to determine the capabilities and limitations of the existing symbology and decoding hardware as they pertain to the diverse and harsh field environment in which they maybe used for, ammunition identification. The tests conducted and their results are presented in this report.

24492 (SAND–92-2086C) **Feature discovery on segmented objects in SAR imagery using self-organizing neural networks.** Fogler, R.J. (Sandia National Labs., Albuquerque, NM (United States)); Koch, M.W.; Moya, M.M.; Hush, D.R. Sandia National Labs., Albuquerque, NM (United States). [1992]. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-930445–1: Society of Photo-Optical Instrumentation Engineers (SPIE) OE/aerospace science and sensing meeting, Orlando, FL (United States), 11-16 Apr 1993). Order Number DE93010685. Source: OSTI; NTIS; GPO Dep.

In this paper we investigate the applicability of the feature extraction mechanisms found in the neurophysiology of mammals to the problem of object recognition in synthetic aperture radar imagery. Our approach is to present multiple views of objects to be recognized to a two-stage self-organizing neural network architecture. The first stage, a two-layer Neocognitron, performs feature extraction in each layer The resulting feature vectors are presented to the second stage, an ART-2A classifier self-organizing neural network which clusters the features into multiple object categories. The feature extraction operators resulting from the self-organization process are compared to the feature extraction mechanisms found in the neurophysiology of vision. In a previous paper, the Neocognitron was trained on raw SAR imagery. The architecture was able to recognize a simulated vehicle at arbitrary azimuthal orientations at a single depression angle while rejecting clutter as well as other vehicles. Feature extraction on raw imagery yielded features that were robust but very difficult to interpret. In this paper we report the results of some new experiments in which the self-organization process is applied separately to shadow and bright returns from objects to be recognized. Feature extraction on shadow returns yield oriented contrast edge operators suggestive of bipartite simple cells observed in the striate cortex of mammals. Feature extraction on the specularity patterns in bright returns yield a collection of operators resembling a twodimensional Haar basis set. We compare the performance of the earlier two-stage neural network trained on raw imagery with a modified network using the new feature set.

24493 (SAND–92-2515C) **The experimental determination of impact forces for modeling of armored vehicle survivability.** Bateman, V.I.; Norwood, F.R.; Carne, T.G. Sandia National Labs., Albuquerque, NM (United States). [1992]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-9303164–1: 4. annual TOCOM combat vehicle survivability symposium, Gaithersburg, MD (United States), 30 Mar - 1 apr 1993). Order Number DE93012857. Source: OSTI; NTIS (US Sales Only); GPO Dep.

A technique to reconstruct dynamic forces applied to structures from measured accelerometer data has been developed at Sandia National Laboratories. This technique is called the Sum of Weighted Accelerations Technique or SWAT. Forces have been successfully reconstructed for the impact limiters on a nuclear transportation cask, the energy-absorbing nose for a simulated bomb, and a lumped mass beam structure. The application of this technique to an armored vehicle hull representation (AVHR) is being studied using an analytical model. This model uses a hydrodynamic code, CTH, to model a projectile penetration, and a transient solid dynamics code, PRONTO, for analyzing the structural response. This analytical model is being used to determine the feasibility of force reconstruction for armored vehicle structures.

24494 (SAND–92-2716C) **Cut-off insensitive guidance with variable time of flight.** White, J.E. Sandia National Labs., Albuquerque, NM (United States). 12 Jan 1993. 9p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-930861–1: American Institute of Aeronautics and Astronautics (AIAA) guidance, navigation, and control conference, Monterey, CA (United States), 9-11 Aug 1993). Order Number DE93006764. Source: OSTI; NTIS (US Sales Only); GPO Dep.

A guidance strategy is proposed for reducing target miss produced by performance uncertainty in the final stage of ballistic missile systems that do not have thrust termination or other velocity control capability. The approach taken here is to turn the thrusting missile onto a null range direction such that performance uncertainty contributions to target miss are reduced. The guidance

algorithm proposed here does not constrain time-of-flight. Since time-of-flight normally varies with thrusting flight along a null range direction, the result is a guidance solution that does not change rapidly near the end of the motor burn. This guidance procedure is a variation of an iterative Lambert guidance scheme that can be used to provide a position constraint with a nearly constant bum attitude by allowing a variable time-of-flight.

24495 (SAND–92-2845C) **3-D massively parallel impact simulations using PCTH.** Fang, H.E.; Robinson, A.C. Sandia National Labs., Albuquerque, NM (United States). [1992]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-930765–2: SCSC '93: summer computer simulation conference, Boston, MA (United States), 19-21 Jul 1993). Order Number DE93011593. Source: OSTI; NTIS; GPO Dep.

Simulations of hypervelocity impact problems are performed frequently by government laboratories and contractors for armor/anti-armor applications. These simulations need to deal with shock wave physics phenomena, large material deformation, motion of debris particles and complex geometries. As a result, memory and processing time requirements are large for detailed, three-dimensional calculations. The large massively parallel supercomputing systems of the future will provide the power necessary to greatly reduce simulation times currently required by shared-memory, vector supercomputers. This paper gives an introduction to PCTH, a next-generation shock wave physics code which is being built at Sandia National Laboratories for massively parallel supercomputers, and demonstrates that massively parallel hydrocodes, such as PCTH, can provide highly-detailed, three-dimensional simulations of armor/anti-armor systems.

24496 (SAND–93-0306) **Extensions of "Some guidelines for the mechanical design of coaxial compression pin seals".** Chambers, R.S.; Burchett, S.N. Sandia National Labs., Albuquerque, NM (United States). Mar 1993. 29p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. Order Number DE93012385. Source: OSTI; NTIS; GPO Dep.

Compression seals are commonly used in electronic components. Because glass has such a low fracture toughness, tensile residual stresses must be kept low to avoid crackS. N. Burchett analyzed a variety of compression pin seals to identify mechanically optimal configurations when work hardened Alloy 52 conductor pins are sealed in a 304 stainless steel housing with a Kimble TM-9 glass insulator. Mechanical property tests on Alloy 52, have shown that the heat treatments encountered in a typical glass sealing cycle are capable of annealing the Alloy 52 pins, increasing ductility and lowering the yield strength. Since most seal analyses are routinely based on unannealed Alloy 52 properties, a limited study has been performed to determine the design impact of lowering the yield strength of the pins in a typical compression seal. Thermal residual stresses were computed in coaxial compression seals with annealed pins and the results then were used to reconstruct design guidelines following the procedures employed by Miller and Burchett. Annealing was found to significantly narrow the optimal design range (as defined by a dimensionless geometric parameter). The Miller-Burchett analyses which were based on very coarse finite element meshes and a 50 ksi yield strength fortuitously predicted an overly conservative design range that is a subset of the narrow design window prevalent when the yield strength is assumed to be 34 ksi. This may not remain true for lower yield strengths. The presence of pin wetting was shown to exacerbate the glass stress state. The time is right to develop a modern and enhanced set of design guidelines which could address new material systems, three dimensional geometries, and viscoelastic effects.

24497 (SAND–93-0858) **Improved Many-On-Many ROUTE software description.** Ormesher, R.C. Sandia National Labs., Albuquerque, NM (United States). Apr 1993. 42p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. Order Number DE93013961. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report describes the models and algorithms used in the Air Force Electronic Warfare Center's (AFEWC's) Improved Many-on-Many (IMOM) ROUTE simulation software. ROUTE simulates an attack aircraft as it penetrates enemy territory that is protected by ground-based search and tracking radars and ground-to-air defensive weapon systems. Self-protection and stand-off jamming are also modelled in the simulation. The overall algorithm for computing the effectiveness of several radars on a single aircraft is described. In particular, the algorithms and mathematical models for calculating the radar range equation, terrain effects using DMA mapping information, weapon system performance, and geometry are described. In addition, the mathematical models and algorithms for calculating the degradation of early-seaming, target-acquisition, fire-control, height-finding, and target-tracking radars due to stand-off and self-protection jammers are described. This document will be useful for analysts who use IMOM and for software developers who modify and extend IMOM's capabilities. Our analysis has examined and validated the theoretical bases for the IMOM ROUTE simulation and its implementation in the software. During the analysis, questions, comments, and concerns were communicated to AFEWC.

24498 (SAND–93-0991C) **Fusion of LADAR and SAR for terminal guidance.** Cress, D.; Mastin, G. Sandia National Labs., Albuquerque, NM (United States). [1993]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-930445–11: Society of Photo-Optical Instrumentation Engineers (SPIE) OE/aerospace science and sensing meeting, Orlando, FL (United States), 11-16 Apr 1993). Order Number DE93012345. Source: OSTI; NTIS (US Sales Only); GPO Dep.

A concept for integrating the airborne sensing capabilities of Synthetic Aperture Radar (SAR) with LAser Detection And Ranging (LADAR) for terminal guidance is presented. The advantages of each technology in the reconnaissance and terminal guidance roles for target acquisition are exploited. The concept is directed at terminal guidance against fixed and quasi-fixed targets (i. e. targets expected to be in approximately the same location and orientation from the time of reconnaissance to the time of targeting). The advantages of airborne SAR are high resolution, all-weather, standoff reconnaissance capabilities. The advantages of LADAR are high resolution in the real aperture mode using moderately sized and priced optics, and good performance over modest ranges (on the order of a kilometer or less). Within the concept, LADAR would provide terminal guidance using two SAR provided data sets: (1) target estimated, and (2) the SAR imagery of target/surround. Technical risk are: lack of a demonstrated capability for SAR-to-LADAR image correlation, lack of analysis of low-cost, light weight LADAR and real-time correlators, and lack of analysis of adequate signal-to-noise in a range of atmospheric environments. This paper is directed at the use of SAR image by the LADAR for aim point refinement. It addresses geometric differences in the SAR and LADAR images, the effect of different reflectances on scene segmentation, and the basis for an approach for developing common geometric projections for the SAR and LADAR image correlations.

24499 (UCRL-ID–111265) **Conventional Strategic Deterrence.** Latter, A.L.; Martinelli, E.A.; Speed, R.D. Lawrence Livermore National Lab., CA (United States). Aug 1992. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE93012444. Source: OSTI; NTIS; GPO Dep.

The Bush Administration argues that the US, as the world's only remaining superpower, must be prepared to intervene militarily in regional conflicts. However, the traditional American way of fighting-relying on ground forces with heavy equipment, supported by naval and air forces–could prove too expensive, both monetarily and in terms of expected American casualties, to garner the support of the American public or Congress. This paper argues that the revolution in conventional weaponry demonstrated in the Persian Gulf War opens up the possibility of a new strategy–called Conventional Strategic Deterrence–that could reduce both financial costs and casualties (if it were necessary to implement the strategy) while still being a strong and credible deterrent to regional conflict.

24500 (UCRL-ID–111898) **Flow visualization of shock propagation in baffle systems.** Kuhl, A.L. (Lawrence Livermore

National Lab., El Segundo, CA (United States)); Reichenbach, H. Lawrence Livermore National Lab., CA (United States). Sep 1992. 18p. Sponsored by USDOE, Washington, DC (United States); Department of Defense, Washington, DC (United States). DOE Contract W-7405-ENG-48. Contract DNA-IACRO 92-824;Contract DNA 001-91-C-0039. Order Number DE93013312. Source: OSTI; NTIS; GPO Dep.

There is renewed interest in blast propagation in multi-chamber systems, related to the vulnerabilities of buried bunker systems to conventional weapons effects. In this short report, the authors suggest some idealized test problems that can be used to evaluate the accuracy of computer code calculations of such problems. The generic problem selected was that of shock wave propagation through a baffle system – either aligned baffles or staggered baffles – as shown schematically in a figure. Here results of shock tube experiments performed previously in the Ernst-Mach-Institut are reported.

24501 (UCRL-JC–107113) **Single crystal tungsten kinetic energy penetrators.** Cline, C.F.; Gogolewski, R.P. Lawrence Livermore National Lab., CA (United States). May 1992. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-920689–6: Symposium on ballistics, Stockholm (Sweden), 1-3 Jun 1992). Order Number DE93012570. Source: OSTI; NTIS; GPO Dep.

We have explored the terminal ballistic performance of single crystal tungsten as a kinetic energy penetrator. Scientific speculation as to the anticipated penetration performance and nature of the interaction between such a kinetic energy penetrator and semi-infinite and spaced metallic targets has led us to perform laboratory scale experiments and metallographic examinations of post-impact penetrator materials. The single tungsten crystals were ground into kinetic energy penetrators with the ⟨111⟩ and ⟨100⟩ crystal direction being coincident with the axis of symmetry of the penetrators. The crystals were electro-polished to their final diameter. We, compared the terminal performance at current ordnance speeds of ⟨111⟩ single crystal tungsten to 90W-10 (NiFe) cemented tungsten and textured pure tungsten in laboratory scale ballistic experiments against a spaced steel (triple) target at sixty-five degrees obliquity. We also compared the terminal performance of ⟨100⟩ and ⟨111⟩ single crystal tungsten with 90W-10 and 98W02 (NiFe) cemented tungsten and textured pure tungsten in laboratory scale ballistic experiments against monolithic 4340 alloy steel (HRC = 36) at normal impact. We radiographed the penetrators during the interactions with the targets, we recovered portions of the penetrators after the ballistic experiments, and we conducted metallographic examinations of penetrator remnants. From the radiographic records and the metallographic examinations, we drew conclusions pertaining to insights into the terminal interactions of the penetrators with the targets and suggestions as to improved compositions of the cemented tungsten penetrators.

24502 (UCRL-JC–107850) **Tools and techniques for estimating high intensity RF effects.** Zacharias, R.; Pennock, S.; Poggio, A.; Ray, S. Lawrence Livermore National Lab., CA (United States). Jul 1991. 8p. Sponsored by USDOE, Washington, DC (United States); National Aeronautics and Space Administration, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9110492–1: Institute of Electrical and Electronics Engineers/American Institute of Aeronautics and Astronautics (IEEE/AIAA) digital avonics system conference, Los Angeles, CA (United States), 14-17 Oct 1991). Order Number DE93012604. Source: OSTI; NTIS; GPO Dep.

With the ever-increasing dependence of modern aircraft on sophisticated avionics and electronic controls, the need to assure aircraft survivatality when exposed to high Intensity RF (HIRF) signals has become of great Interest. Advisory regulation is currently being proposed which would require testing and/or analysis to assure RF hardness of installed flight critical and flight essential equipment. While full-aircraft, full-threat testing may be the most thorough manner to assure survivability, it is not generally practical in loins of cost. Various combinations of limited full-aircraft testing, box-level testing, modeling, and analysis are also being considered as methods to achieve compliance. Modeling, analysis, and low power measurements may hold the key to making full-system survivability estimates at reasonable cost. In this paper we will describe some of the tools and techniques we use for estimating and measuring coupling and component disturbance. A finite difference time domain modeling code, TSAR, used to predict coupling will be described. This code has the capability to quickly generate a mesh model to represent the test object. Some recent applications as well as the advantages and limitations of using such a code will be described. We will also describe some of the facilities and techniques we have developed for making low power coupling measurements and for making direct injection test measurements of device disturbance. Some scaling laws for coupling and device effects will be presented. A method to extrapolate these low-power test results to high-power full-system effects will be presented.

24503 (UCRL-JC–109857) **The urban combat computer assisted training system, UCCATS.** McGuigan, D.L. Lawrence Livermore National Lab., CA (United States). 30 Mar 1992. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-920771–6: 1992 summer computer simulation conference, Reno, NV (United States), 27-30 Jul 1992). Order Number DE93012590. Source: OSTI; NTIS; GPO Dep.

With the ability to represent individual buildings with one decimeter accuracy on a 100 kilometer square battlefield, UCCATS provides a unique capability for training combat forces. Combat situations that transition from rural to urban environments are easily supported. The high resolution terrain is coupled with an item system resolution paradigm for combat adjudication. The simulation core is only one component of an integrated system that includes database preparation utilities and an integrated after action reporting capability.

4501 Chemical Explosions and Explosives

Refer also to citation(s) 24114, 24133, 24955, 25008

24504 (CONF-921275–, pp. 25-26) **Hazard evaluation on organic peroxides.** Jinnouchi, T. (Nippon Oil and Fats Co. Ltd., Tokyo (Japan)); Shimizu, M. 2 Dec 1992. 160p. (In Japanese). From 25. safety engineering study meeting; Kitakyushu (Japan); 2-3 Dec 1992. In *Proceedings of the 25th Safety Engineering Study Meeting.* Order Number DE93793904. Source: OSTI; NTIS (US Sales Only).

Organic peroxides utilized as polymerization starting agent and hardening agent have on the other hand a danger of fire and explosion. This paper describes investigations on readiness and activeness of heat decomposition in about 40 kinds of organic peroxides that have alkyl groups and aralkyl groups. Readiness of heat decomposition occurrence was investigated by measuring decomposition temperatures and decomposition heat at a heating rate of 10°C/min using a heat analyzing and testing equipment. A pressure container test measured pressures generated when the materials were heated at a rate of 30°C/min in a container. Further, the materials were charged and detonated in a mortar to measure mortar deflection angles and compare the powers with the TNT explosive. Looking at a 10-hour half-life temperature T10 that represents heat decomposition activity revealed that there are materials either showing or not showing decomposition activities depending on chemical compositions; the temperature T10 has in many cases a good correlation with decomposition temperatures derived from heat analysis; and active oxygen and CO groups can serve as a reference for activeness and power of decomposition. 3 figs., 2 tabs.

24505 (CONF-921275–, pp. 27-28) **Hazard evaluation on mixed contacts in reaction reagents.** Takenouchi, H. (Fujisawa Pharmaceutical Co. Ltd., Osaka (Japan)); Shima, K.; Inoue, S.; Nakamura, H. 2 Dec 1992. 160p. (In Japanese). From 25. safety engineering study meeting; Kitakyushu (Japan); 2-3 Dec 1992. In *Proceedings of the 25th Safety Engineering Study Meeting.* Order Number DE93793904. Source: OSTI; NTIS (US Sales Only).

Scaling up an organics synthetic reaction requires detailed hazard evaluation that takes into account actual operating conditions, in addition to using literature information on individual reaction reagents. This paper reports results of a mixed contact hazard evaluation on two kinds of reagents used relatively generally. The

test consists of heat analysis, time-based measurement of temperatures in liquid mixtures placed in a Dewar bottle, and video observation. A condensed liquid mixture of methachlor perbenzoic acid (m-CPBA) and dimethylformamide (DMF) decomposed and generated heat vigorously at around 70°C in a Dewar bottle test, and reached 180°C to 190°C. This heat storage and decomposition phenomenon was thought a result of a specific reaction of m-CPBA + DMF system, rather than from effects of impurities contained in the m-CPBA. A hazard test subsequently carried out on mixed contacts of t-BuOK with various solvents provided new findings including that no danger of ignition with water can be recognized, occurrence of which had been indicated previously. 1 ref., 5 figs., 1 tab.

24506 (CONF-921275–, pp. 65-68) **Electrostatic dust ignition mechanism for priming materials. 2.** Kuroda, E. (Nippon Koki Co., Tokyo (Japan)); Nagaishi, T. 2 Dec 1992. 160p. (In Japanese). From 25. safety engineering study meeting; Kitakyushu (Japan); 2-3 Dec 1992. In *Proceedings of the 25th Safety Engineering Study Meeting.* Order Number DE93793904. Source: OSTI; NTIS (US Sales Only).

Easiness in igniting explosives and priming materials is measured using electrostatic discharge. Subsequent to the previous report in which sensitivity characteristics of aluminum to an electrostatic dust ignition mechanism were reported, this paper describes discussions on mixture system of magnesium and an oxidizer. The test used a fixed electrode device consisting of an upper electrode of a phonograph record needle and a rod-shaped lower electrode with a diameter of 6 mm, magnesium powder for a test specimen, and triferric tetroxide for an oxidizer. The powder was placed on the lower electrode flatly and thinly to 1 mm or less. Discharges were performed with capacitors with 4,000 pF to 30,000 pF, series resistors with 2 k ohm to 400 k ohm, and electrode distances from 0.02 mm to 3 mm. The conclusions indicated that magnesium has much higher sensitivity than aluminum, and has short apparent time constants. The minimum 50% igniting energies for both materials were 100 m joule and 1 m joule, respectively. The mixture system of magnesium with the oxidizer was still more sensitive with the energy of about 0.3 m joule. 2 refs., 7 figs.

24507 (CONF-921275–, pp. 69-70) **Evaluation on explosion force of solid substances by measuring detonation pressures.** Miyake, A. (Yokohama National University, Yokohama (Japan). Faculty of Engineering); Ogawa, T. 2 Dec 1992. 160p. (In Japanese). From 25. safety engineering study meeting; Kitakyushu (Japan); 2-3 Dec 1992. In *Proceedings of the 25th Safety Engineering Study Meeting.* Order Number DE93793904. Source: OSTI; NTIS (US Sales Only).

Detonation characteristics of condensed-system explosive materials are expressed by detonation rate, pressure, and temperature as important parameters. The pressure and the temperature have been calculated generally from the detonation rate according to theoretical calculations. However, the calculation uses an ideal detonation as its prerequisite, whereas in this paper discussions were given on non-ideal detonation in an emulsion explosive that exhibits non-ideal detonation by measuring directly the detonation rate and the pressure under different conditions. The explosive used for the experiment was an emulsion comprising ammonium nitrate, wax, and water, added with an adequate amount of glass micro balloon. The detonation rates were measured using an ion gap method, and the detonation pressures by using an experimental device that uses a manganin gauge made from piezo resistance elements. As a result of discussing the detonation characteristics in various ways using the method and the device, the detonation rates showed values equivalent to experimental and calculated values as referred to in literatures, while the detonation pressures showed lower values than the calculations, indicating the detonating condition being non-ideal. 1 ref., 5 figs.

24508 (CONF-921275–, pp. 75-78) **Measurement of ignition points in spontaneously reactive substances.** Kaneko, Y.; Aimoto, H.; Katsuhara, I.; Ogai, A. 2 Dec 1992. 160p. (In Japanese). From 25. safety engineering study meeting; Kitakyushu (Japan); 2-3 Dec 1992. In *Proceedings of the 25th Safety Engineering Study Meeting.* Order Number DE93793904. Source: OSTI; NTIS (US Sales Only).

A difference was investigated between the ignition point testing method in the quasi-ASTM method which improved part of the ASTM method and the Krupp ignition point testing method which is used frequently for explosives. The test specimens included nitro compounds and 12 other kinds of spontaneously reactive solid substances. While the ASTM method uses the explosives in an amount from 50 mg to 150 mg, this study limited it to 20 mg at maximum. An ignition temperature was established as a lowest temperature at which an ignition waiting time after the test specimen has been charged is five minutes or longer. With the Krupp method, a temperature for a four-second waiting time (ignition point AIT_K) was sought from a straight line plotted with inverse numbers of the absolute temperature and logarithms for the ignition waiting time. As a result, it was recognized that some of the spontaneously reactive substances disable plotting the numbers with use of the time-temperature relationship in the Krupp method; that the ASTM method has a limitation for measuring the test specimen amount and the ignition waiting time if the test specimen is a solid substance; and the ignition points have a good linear relationship in the values obtained from both methods. 5 figs., 4 tabs.

24509 (CONF-921275–, pp. 101-104) **Study on vapor explosiveness of molten LiCl-water system.** Umetsu, T. (Yokohama National University, Yokohama (Japan). Faculty of Engineering); Otani, H.; Uehara, Y. 2 Dec 1992. 160p. (In Japanese). From 25. safety engineering study meeting; Kitakyushu (Japan); 2-3 Dec 1992. In *Proceedings of the 25th Safety Engineering Study Meeting.* Order Number DE93793904. Source: OSTI; NTIS (US Sales Only).

Although vapor explosion that occurs when a high-temperature liquid contacts a low-temperature liquid is known in the metal industry, no sufficient knowledges have been attained on its generation mechanism. Subsequent to the previous report that investigated explosion probabilities and forces of vapor explosions of an Li-Cl-water system, the present paper discusses behavior of the pressures generated from single drop explosion. Molten test sample in a crucible with a bottom plug was dripped into a tank filled with 2000 cm^3 of water at a fixed temperature, and pressure changes in the water were measured using a pressure converter located at the bottom of the tank. Signals were transmitted and processed in a wave memorizer and a personal computer. The experimental result may be summarized as follows: The shape of a pressure waveform in a region with molar heat exergy of the molten LiCl from about 30.5 to 32 kJ/mol differs from that in other regions; and when the heat exergy of the molten LiCl increases, the maximum value for a largest generated pressure increases, but there may be occasions that the generated pressure is small. 4 refs., 6 figs.

24510 (CONF-921275–, pp. 105-106) **Flash reducing performance and explosion force dissipating effect of a metal-screen type flame arrestor.** Suzuki, Y. (Yokohama National University, Yokohama (Japan). Faculty of Engineering); Miyake, A.; Ogawa, T. 2 Dec 1992. 160p. (In Japanese). From 25. safety engineering study meeting; Kitakyushu (Japan); 2-3 Dec 1992. In *Proceedings of the 25th Safety Engineering Study Meeting.* Order Number DE93793904. Source: OSTI; NTIS (US Sales Only).

Flame arrestors to block flame propagation have not necessarily been elucidated of the reasonability of their design formulas. This paper describes experimental discussions on effects of the number of metal screens and the clearance between the screens on flame reducing performance of a multi-layer metal-screen type flame arrestor. An explosion pipe with a diameter of 100 mm was partitioned by a metal screen at its center, and electric spark was used as the ignition source. Propane-air mixture gas was used, and the flame velocity was adjusted by varying the propane concentration. The flame velocity was detected by an optical fiber and a photo diode, and the average velocity was assumed as the entering velocity of a flame into the flame arrestor. When the flame is quenched, the downstream flame velocity is zero. An experimental expression for the flame reducing performance of the flame arrestor was obtained from the experimental result, using a shape coefficient of the metal screen (wire diameter/mesh width). Such a finding was also obtained that the flame reducing performance on the propane-air mixture gas improves sharply with up to six metal screens according to the power function, but no changes in the

performance can be recognized even the number of the screen is increased. 5 figs.

24511 (CONF-921275–, pp. 109-112) **Effects of closed space height on pressure variation as a result of evaporation and ignition of combustible liquids.** Sato, K. (Toho University, Tokyo (Japan). Faculty of Science); Sakai, Y.; Nakagawa, K. 2 Dec 1992. 160p. (In Japanese). From 25. safety engineering study meeting; Kitakyushu (Japan); 2-3 Dec 1992. In *Proceedings of the 25th Safety Engineering Study Meeting.* Order Number DE93793904. Source: OSTI; NTIS (US Sales Only).

For a purpose of assuring safety in storing and handling liquid fuels, combustion experiments have been carried out to identify characteristics of ignition and explosion of vapors of the liquid fuels. An experiment was performed in a more practical space, using a larger pressure vessel than that used in the experiments reported previously, to discuss effects of the vessel height on relation of evaporation time (τ) with pressure change and maximum pressure rise. Two kinds of vessels were used that have an inner diameter of 100 mm and heights (H) of 100 mm and 200 mm. They were held in a water bath to adjust temperatures. The test specimen used was 4 ml of methanol injected from the bottom center. The liquid was ignited with an electric spark generated 4 mm above the bottom, the pressure was measured using a strain gauge pressure converter, and the waveform was recorded digitally. A two-step pressure rise was recognized when τ is short, as also reported previously. Its appearance and the maximum pressure were considered to change in association with the temperature and H that affect the preliminary mixing. Even with the case where the H varies, the phenomena were put in order nearly consistently by means of introducing non-dimensionalized τ. 4 refs., 9 figs.

24512 (CONF-921275–, pp. 117-120) **Measurement of reaction limits of TEOS, H2, NH3 and ClF3.** Otani, H. (Yokohama National University, Yokohama (Japan). Faculty of Engineering); Uehara, Y.; Enomoto, T. 2 Dec 1992. 160p. (In Japanese). From 25. safety engineering study meeting; Kitakyushu (Japan); 2-3 Dec 1992. In *Proceedings of the 25th Safety Engineering Study Meeting.* Order Number DE93793904. Source: OSTI; NTIS (US Sales Only).

Studies have been carried out on explosion risks in gas mixtures of ClF3 used in semiconductor cleaning processes with combustible gases. Subsequent to the previous report that has investigated the dichloro silane system and the monosilane system, the present paper describes measurement of reaction limits of ethyl orthosilicate (TEOS), H2, NH3, and ClF3. In the case of H2, a premixture of H2, ClF3 and N2, and in the case of TEOS and NH3, vapor generated from the liquids in a flask, were guided directly into a reaction container and adjusted to predetermined concentrations. The reaction container is a pressure container with an inner diameter of 100 mm and a height of 120 mm, and the liquids were ignited electrically. As a result, the limit concentrations for the respective systems were plotted on a triangular diagram (for composition) to indicate that a limit of spontaneous ignition in, for example, ClF3/TEOS/N2 gas mixture was about 0.6% by volume in terms of the ClF3 concentration, and about 0.2% by volume in terms of the TEOS concentration. 4 refs., 9 figs.

24513 (CONF-921275–, pp. 121-122) **Ignition limit for hydrogen-air mixture gas on opening spark from hi-frequency electric circuit.** Motoyama, T. (Research Institute of Industrial Safety, Tokyo (Japan)). 2 Dec 1992. 160p. (In Japanese). From 25. safety engineering study meeting; Kitakyushu (Japan); 2-3 Dec 1992. In *Proceedings of the 25th Safety Engineering Study Meeting.* Order Number DE93793904. Source: OSTI; NTIS (US Sales Only).

A great number of studies have been reported on ignition limits for combustible gases on electric sparks, but many of them are about electric sparks in direct current or low frequency circuits. Taking accounts for high-frequency electrical devices used in hazardous atmosphere, this paper describes measurements of ignition limit for hydrogen-air gas mixture in a frequency range from 1 kHz to 1000 kHz using an IEC-type spark ignition testing device. The maximum number of opening of the electrodes was set to 3000 openings for each electrode, during which ignition and non-ignition were determined. The gas mixture is a hydrogen-air mixture with hydrogen concentration of 21.0% $\pm$ 2% by volume. The results of the experiment may be summarized as follows: The ignition voltage and its corresponding current increase as the frequency is increased; because the discharge is paused each time the current becomes zero, calculations that hypothesize that discharge energy in a half cycle relates with the ignition showed an identical trend; however, nearly all the measurements showed values smaller than the calculations. 2 refs., 3 figs.

24514 (CONF-921275–, pp. 135-136) **Reduction in vibration using precisely controlled blasting.** Wada, Y. (National Institute for Resources and Environment, Tsukuba (Japan)); Ogata, Y.; Katsuyama, K.; Nakajima, T.; Ogawa, T. 2 Dec 1992. 160p. (In Japanese). From 25. safety engineering study meeting; Kitakyushu (Japan); 2-3 Dec 1992. In *Proceedings of the 25th Safety Engineering Study Meeting.* Order Number DE93793904. Source: OSTI; NTIS (US Sales Only).

The problem of vibration and stone scattering could be reduced by using stepped blasting. However, the step time that can be set in conventional MS and DS detonators is in the order of several ten microseconds, which is not sufficient for the control. This paper discusses the relationship between step times and vibration reduction by experimenting several blasting sources to control their blasting time in 1μs increments. An acrylic plate with a length of 35 cm, a width of 129 cm and a thickness of 2 cm was used as a vibration propagating media, and a precise exploder was used to control the blasting time in 1μs increments. Fuse heads and bridge circuit were prepared as vibration sources. In an experiment using two fuse heads for example, the optimal step time was found to be between 20μs and 28μs, and the maximum displacement rate was reduced to about 60% of that with a simultaneous blasting. It was verified that proper selection of the step time can reduce the vibration, and the maximum vibration value agrees well with calculations of the self-correlation function, suggesting that the correlation function may be able to determine the step time. 4 figs.

24515 (CONF-921275–, pp. 161-162) **Correlation of DSC measurement results on benzene monocyclic derivative with its chemical structure.** Fujimoto, Y. (Research Institute of Industrial Safety, Tokyo (Japan)); Ando, T.; Morisaki, S. 2 Dec 1992. 160p. (In Japanese). From 25. safety engineering study meeting; Kitakyushu (Japan); 2-3 Dec 1992. In *Proceedings of the 25th Safety Engineering Study Meeting.* Order Number DE93793904. Source: OSTI; NTIS (US Sales Only).

With an objective to develop a method to predict energy hazards using chemical structure, an analysis was made on relationship of DSC measurement results on benzene monocyclic derivative with its chemical structure, especially with a heat generation starting temperature. A model to predict the heat generation starting temperature was discussed using the association and dissociation energy as a parameter. The dissociation energy index (DEI) was assumed to be 1/[association and dissociation energy (Kcal/mol)] $\times$ (10000). This indicates that the larger the figure, the association and dissociation energy is smaller, and the structure can be destroyed more easily, that is, more dangerous. A functional group index (FGI) was also made for correction. In an attempt to make predictions utilizing fuzzy inference methods, the DEI and the FGI were divided respectively into a large group (L) indicating a large hazard, and a small group (S) indicating a small hazard. An index referred to as TI was developed as an inverse number for the heat generation starting temperature, which was divided into three groups of S, M, and L. An inference was made using an inference rule to compare the predictions with the measurements. 1 tab.

24516 (CONF-921275–, pp. 113-116) **Characteristics of aluminum alloy in methane gas ignition by impact friction spark.: Ignition suppressing effect with surface preparation.** Komai, T. (National Institute for Resources and Environment, Tsukuba (Japan)); Uchida, S.; Shikada, N.; Tanaka, M. Dec 1992. 160p. (In Japanese). From 25. safety engineering study meeting; Kitakyushu (Japan); 2-3 Dec 1992. In *Proceedings of the 25th Safety Engineering Study Meeting.* Order Number DE93793904. Source: OSTI; NTIS (US Sales Only).

Impact friction spark generated between a light alloy and a carbon steel has high risk of igniting and exploding combustible gases including methane. The present study carried out experiments on

spark generation when aluminum alloys were given a metal spraying surface preparation (Metallikon) and on the ignition suppression effect of the treatment. Ordinary paints were also experimented for comparison. Two kinds of aluminum alloys were used, namely duralmin A2017 and Al-Zn-Mg-based A7075. Two kinds of metals, copper and stainless steel, were used for sprayed films, and the paints used were anticorrosion primer paints and synthetic resin paints. The results of experiments using a drop impact testing device may be summarized as follows: A copper Metallikon treatment with thickness from 0.3 mm to 0.8 mm reduced the ignition factor down to 10% to 20%, proving a sufficient effect. Surface preparations using the paints exhibited smaller effects than the Metallikon, but can be expected of fair effects when painted so thick that no separation can occur. 1 fig., 3 tabs.

24517 (EGG-M–92417) **Design and calibration of pulsed vapor generators for TNT, RDX and PETN.** Davies, J.P.; Blackwood, L.G.; Davis, S.G.; Goodrich, L.D.; Larson, R.A. EG and G Idaho, Inc., Idaho Falls, ID (United States). [1992]. 29p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-76ID01570. (CONF-9209325–1: 4. International symposium on analysis and detection of explosives, Jerusalem (Israel), 7-10 Sep 1992). Order Number DE93010622. Source: OSTI; NTIS; GPO Dep.

Computer controlled explosive vapor generators for 2,4,6trinitrotoluene (TNT), cyclo-1,3,5-trimethylene-2,4,6-trinitramine (RDX) and pentaerythritol tetranitrate (PETN) were built and calibrated to support an Independent Validation and Verification (IV&V) facility for Explosive Detection Systems (EDS) for the Federal Aviation Administration (FAA) at the Idaho National Engineering Laboratory. The generators were constructed using pure explosive suspended on quartz beads which were then loaded into a stainless steel tube. The tube was coiled and placed into a temperature controlled chamber. A carrier gas (ultra-pure air) was passed through the coil to carry the explosive molecules. The generators are capable of delivering a pulse of varying explosive mass through the control of coil temperature, air flow rate, and pulse width. Preliminary calibrations have been completed in the picogram to nanogram range using an Ion Mobility Spectrometer (IMS) as the calibrating instrument. The explosive vapor generators will be used as quantitative vapor standards to establish the lower limit of detection for EDS systems at the IV&V.

24518 (LA–12455-MS) **Synthesis and characterization of 1,4-dinitroglycoluril (DINGU).** Sanchez, J.A.; Stinecipher, M.M.; Stretz, L.A. Los Alamos National Lab., NM (United States). Jun 1993. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. Order Number DE93014111. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The synthesis and properties of 1,4-dinitroglycoluril (DINGU) have been studied. Isomers formed during the DINGU synthesis reaction were identified. The synthesis reaction was scaled up and reaction conditions optimized to produce the maximum yield of DINGU. This study evaluated DINGU as an energy contributing material in cast and plastic-bonded explosive formulations. Plastic coating of DINGU into a plastic-bonded explosive using several binders was also investigated. Testing indicated that DINGU has lower than expected explosive performance both as a pure material and when formulated in a plastic-bonded explosive.

24519 (LA-SUB–93-150) **Characterization of metal-loaded plastics: [Final report].** Thadhani, N. (New Mexico Inst. of Mining and Technology, Socorro, NM (United States). Center for Explosives Technology Research). Los Alamos National Lab., NM (United States); New Mexico Inst. of Mining and Technology, Socorro, NM (United States). Center for Explosives Technology Research. [1993]. 18p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. Order Number DE93011247. Source: OSTI; NTIS; GPO Dep.

The purpose of this effort was to establish a reliable technique for bulk modulus measurements of tungsten-filled plastics. Bulk modulus determination of elastic materials is difficult and no standard technique has yet been developed. This is especially true for metal- filled plastics. Currently, the means of determining bulk modulus for a heavily filled plastic is one of extrapolation, rather then direct measurement and the accuracy of such extrapolated values is open to question. Two techniques were chosen for this study. The MTS hydrostatic pressure method utilizes a hydrostatic pressure call in which pressures ranging from 30-60 MPa can be generated in conjunction with a standard MTS testing machine. Corresponding strains are measured by strain gages or with longitudinal or circumferential extensometers. The ultrasonic velocity measurement method results in the direct measurement of pulse velocities of compression and/or shear waves in the material under strain. The bulk modulus is then calculated from the measured sonic velocities. This technique is an adaptation of an AISI technique for the measurement of elastic constants of isotropic materials. Equipment and hardware already exist at the New Mexico Institute of Mining Technology. CETR's principle investigator for this project. Dr. Nareesh Thadhani arranged for the use of the equipment once test specimens were prepared by Los Alamos and shipped to CETR. This arrangement was made in collaboration with Drs. Kalman Orevocz and Catherine Aimone from the Department of Mining Engineering. The task was separated into two phases. Phase 1 included a preliminary effort at test specimen fabrication and testing with each technique. Phase 2 included review of the Phase I results and selection of the best technique.

24520 (LA-SUB–93-184) **Computer modeling program for fragment trajectories within a bomb stack: Final report.** Pratt, D.A. (Morton Thikol, Inc., Brigham City, UT (United States). Utah Operations); Clark, D.P. Los Alamos National Lab., NM (United States); Morton Thikol, Inc., Brigham City, UT (United States). Utah Operations. 25 May 1989. 54p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract W-7405-ENG-36. Order Number DE93013916. Source: OSTI; NTIS; GPO Dep.

The large aerial bombs used by the Air Force are arranged in stack arrays within storage magazines. The effects of the inadvertent detonation of one bomb on other bombs in the stack or within the magazine are of critical importance and a means to prevent sympathetic detonation from occurring must be found if the integrity of the stored bombs is to be maintained. Los Alamos National Laboratory has been funded to explore the phenomena involved in the bomb stack and to evaluate systems to prevent the mutual detonation of adjacent bombs in the event of the detonation of a single bomb. A problem in addressing this project is the acceleration and deceleration of high velocity fragments emerging from the detonating bomb and the trajectories of these fragments through the bomb stack. Tests were conducted by the Air Force using a 3-row by 5-column bomb stack array. The array was fitted with a polymethylmethacrylate (PMMA) mitigation system consisting of blocks both between all adjacent bombs as well as in the center of each four-bomb rectangular array. The outside-upper corner bomb (1-1) was detonated (the donor). While bombs adjacent to the donor were protected from the effects of the blast by the PMMA mitigators, bombs sympathetically detonated were two rows and three columns away (3-4) and two rows and four columns away (3-5) from the donor. The purpose of this program was to perform numerical modeling of the physical processes involved in the flow of fragments within the bomb stack. The desired result was to predict the paths of the fragments and their impact velocities on any other bomb in the stack. In the modeling work covered by this report, the fragments are allowed to collide with stack elements, rebound from them, or travel unimpeded through the array. Elements of the bomb stack are acted on by gravity and drag forces as well as blast winds generated from the detonating explosive.

24521 (LA-UR–93-1119) **Temperature effects on failure thickness and deflagration-to-detonation transition in PBX 9502 and TATB.** Asay, B.W.; McAfee, J.B. Los Alamos National Lab., NM (United States). [1993]. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930713–6: 10. detonation symposium, Boston, MA (United States), 12-16 Jul 1993). Order Number DE93010742. Source: OSTI; NTIS; GPO Dep.

The deflagration-to-detonation (DDT) behavior of TATB has been investigated at high temperatures and severe confinement. comparison is made to other common explosives under similar confinement. TATB did not DDT under these conditions. The failure

thickness of PBX 9502 at 250°C has also been determined. Two mm appears to be the limiting value at this temperature.

24522 (LA-UR–93-1180) **Jet initiation thresholds of nitromethane.** Asay, B.W.; Pauley, D.J.; Ferm, E.N. Los Alamos National Lab., NM (United States). [1993]. 8p. Sponsored by USDOE, Washington, DC (United States); Department of Defense, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930713–9: 10. detonation symposium, Boston, MA (United States), 12-16 Jul 1993). Order Number DE93012627. Source: OSTI; NTIS; GPO Dep.

The initiation criterion for nitromethane and diethylenetriamine-sensitized solutions has been established over a confined range of jet diameters, velocities, and failure diameters. The data were normalized with the failure diameter that was chemically modified, and they support the hypothesis that the failure diameter should be made part of the critical initiation function. The difference between physically- and chemically sensitized NM in promptness of initiation, as measured by corner turning distance, was not statistically significant. The diameter of the Viper jet has been characterized over a wide range of velocities.

24523 (LA-UR–93-1557) **A study of the role of homogeneous process in heterogeneous high explosives.** Tang, P.K. Los Alamos National Lab., NM (United States). [1993]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930713–10: 10. detonation symposium, Boston, MA (United States), 12-16 Jul 1993). Order Number DE93012733. Source: OSTI; NTIS; GPO Dep.

In a new hydrodynamic formulation of shock-induced chemical reaction, we can show formally that the presence of certain homogenous reaction characteristics is becoming more evident as shock pressure increase even in heterogeneous high explosives. The homogeneous reaction pathway includes nonequilibrium excitation and deactivation stages prior to chemical reaction. The excitation process leads to an intermediate state at higher energy level than the equilibrium state, and as a result, the effective activation energy appears to be lower than the value based on thermal experiments. As the pressure goes up higher, the homogeneous reaction can even surpass the heterogeneous process and becomes the dominant mechanism.

24524 (ORNL/TM–12274) **Thermal response of gator system internal components.** Moyers, J.C.; Childs, K.W.; Stovall, T.K. Oak Ridge National Lab., TN (United States). 15 Apr 1993. 35p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93012996. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The Gator Weapon System may be subjected to severe temperature extremes. One internal component of this system is known to be sensitive to very low temperatures. An analysis of the system was therefore made to determine the relationship between the environmental temperatures and the Gator's internal temperature profile. These internal temperature projections can then be used to define the external conditions under which the system would be prone to failure. Three detailed computer models and one simplified model were used to explore the thermal response of the Gator to a step environmental temperature change. The response to this nondimensionalized step change can then be used to predict the internal Gator temperatures for a variety of mission profiles. The study was also therefore able to determine if there was a possibility that the Gator would encounter the necessary external conditions required to bring about the cold temperature failure scenario. The results show the Gator mines to be well protected with a relatively slow thermal response. For example, given an initial temperature of (15.6°60°F) and a recovery temperature of −40°C (40°F) [this recovery temperature is the result of a speed of Mach 0.77, recovery factor of 0.89, and ambient temperature of −62.2°C (−80°F)], the critical component temperature drops to the limiting value of −31.7°C (−25°F) only after exposure times greater than 12 hours.

24525 (SAND–93-0757C) **Calibration of the BKW–EOS and application to aluminized composite explosives.** Hobbs, M.L.; Baer, M.R. Sandia National Labs., Albuquerque, NM (United States). [1993]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-9306150–1: 5. international conference of the Groupe de Travail de Pyrotechnie, Strasbourg (France), Jun 1993). Order Number DE93011671. Source: OSTI; NTIS; INIS; GPO Dep.

The Becker-Kistiakowsky-Wilson equation of state (BKW-EOS) has been calibrated over a wide initial density range near C-J states using measured detonation properties from 62 explosives at III total initial densities. Values for the empirical BKW constants α, β, κ, and θ were 0.5, 0.298, 10.5, and 6620, respectively. Covolumes were assumed to be invariant. Model evaluation includes comparison to measurements from 91 explosives composed of combinations of Al, B, Ba, C, Ca, Cl, F, H, N, 0, P, Pb, and Si at 147 total initial densities. Adequate agreement between predictions and measurements were obtained with a few exceptions for nonideal explosives. However, detonation properties for the nonideal explosives can be predicted adequately by assuming partial equilibrium. The partial equilibrium assumption was applied to aluminized composites of RDX, HMX, TNETB, and TNT to predict detonation velocity and temperature.

24526 (SAND–93-1091C) **Violence-of-reaction experiments.** Fischer, S.H.; Benham, R.A. Sandia National Labs., Albuquerque, NM (United States). [1993]. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-9305189–2: 1993 joint Army, Navy, NASA, Air Force (JANNAF) Propulsion Systems Hazards Subcommittee meeting, Ft. Lewis, WA (United States), 10-14 May 1993). Order Number DE93013758. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The measurement of the violence of reaction produced when an energetic material is subjected to a cookoff environment has been poorly quantified in most experiments and accidents. Calculations of critical temperature and time to cookoff calibrated to experiments are often in agreement with experimental observations. However, the violence of reaction is sometimes very sensitive to the static and dynamic confinement, condition of the material and thermal history. It is difficult to quantify and correlate with these parameters due to the long heatup phase and rugged temperature requirements. Strong confinement is important since changes in the free volume and degree of venting are controlling parameters, but such confinement makes internal diagnostics of the state and chemistry of the sample very difficult. Intrusive diagnostics can also interfere in mass and energy transport processes in the sample. The authors have developed a one-dimensional cookoff-confinement experiment that automatically controls the thermal history while massive lateral confinement allows quantification of the violence of reaction through pressure, strain, and piston-velocity measurements. Up to 20 grams of energetic material is heated until a piston assembly fractures and the piston is driven up the barrel of the fixture. The quasistatic and dynamic pressure produced by the sample are measured with pressure transducers. They also measure the strain on the fracture web of the piston assembly. When the piston assembly fractures, the velocity of the portion traveling up the barrel is measured with VISAR (velocity interferometric system for any reflector). The pressure, strain, and velocity measurements are related and characterize the violence of reaction. Since the method for conducting these experiments has been developed, further testing with this hardware is on hold until coupled thermal, structural, and chemical computer codes are available.

24527 (UCRL-ID–112425) **Fabry Perot velocimetry on detonating LX-17 in planar and spherically divergent geometries.** Bahl, K.L.; Breithaupt, R.D.; Tarver, C.M.; Von Holle, W.G. Lawrence Livermore National Lab., CA (United States). Dec 1992. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE93013785. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Fabry Perot velocimetry and hydrodynamic calculations are used to quantitatively, determine the strengths of planar and spherically divergent detonation waves in LX-17 as functions of initial temperature, booster explosive and propagation direction. Cold LX-17 is shown to initiate more slowly than ambient temperature LX-17 but to eventually attain an equivalent detonation wave structure. LX-10 (HMX) boosters provide a greater initial momentum than do ultrafine TATB boosters, but the resulting LX-17 detonation waves are equivalent within 20 mm of propagation. No direction dependence

is observed between 0° and 60° from the pole. Comparison of these experimental velocity histories to CJ and ignition and growth ZND reactive flow calculations demonstrate that well defined LX-17 reaction zones with pressures well above Chapman-Jouguet (CJ) values are developed within one reaction zone length of propagation. After 20 to 30 mm of propagation, the LX-17 detonation waves approach steady state and the experimental records agree closely with the reactive flow calculations, CJ calculations are 4–5% low in velocity.

24528 (UCRL-ID–112431) **Performance properties of the emulsion explosive QM-100.** Garza, R.; Helm, F.; Souers, P.C.; Simpson, R.L. Lawrence Livermore National Lab., CA (United States). Dec 1992. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE93013786. Source: OSTI; NTIS; GPO Dep.

QM-100 was evaluated in cylinder expansion configuration to determine the detonation production equation of state. Two experiments were run. No differences in scaled cylinder wall expansions could be determined; hence, despite a diameter effect on detonation velocity, metal acceleration was the same for both experiments. Max expansion volumes were limited, $\sim 4\ V/V_o$. This was interpreted to be result of significant inhomogeneities in the emulsion explosive fills which in turn produced a nonuniform detonation and ruptured the cylinders. 7 refs., 6 figs., 4 tabs.

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Refer also to citation(s) 22943, 24564, 24565, 24757, 24789, 24955, 25008, 25315

24529 (CONF-9109114–Vol.1, pp. 3-15) **Nuclear magnetic resonance determination of the non-pore water content of zeolite tuffs and its application to correction of epithermal-neutron-log-derived water content.** McKague, H.L. (Lawrence Livermore National Lab., CA (US)); Hearst, J.R.; Ward, R.L. Lawrence Livermore National Lab., CA (United States). [1991]. DOE Contract W-7405-ENG-48. From 6. symposium on containment of underground nuclear explosions; Reno, NV (United States); 24-26 Sep 1991. In *Sixth symposium on containment of underground nuclear explosions: Proceedings: Volume 1.* 491p. Order Number DE92041091. Source: OSTI; NTIS (US Sales Only).

Saturations in excess of 100% are commonly calculated from measured grain density, bulk density and water content in clinoptilolite - bearing volcanic rocks. Clinoptilolite affects the property measurements in two ways. First the clinoptilolite produces inaccurate grain density measurements by interacting with the water or gas in the pycnometer. Second the protons in the non-pore water within the clinoptilolite structure are measured by the epithermal neutron tool and assumed to be part of the pore water in the calculation of saturation, frequently resulting in excessive saturations. Proton wideline pulsed Nuclear Magnetic Resonance (NMR) was used to measure all proton species contained within the rock samples. The Fourier transformed spectra were integrated and compared with an NBS standard of benzoic acid to yield grams of protons per gram of sample. Bound and free (mobile) water in rocks are distinguished by the NMR linewidth. Therefore we are able to distinguish and measure the non-pore water in the sample. Fifty samples from U4av were run to determine the applicability of the procedure. The amount of bound zeolitic water in the as-received samples ranged from 0.3 to 8.9 wt%. The neutron log was corrected for non-pore water and saturation was recalculated using free water only. Saturation was substantially reduced. To test the sensitivity of the samples to sample handling procedures ten samples were split and the splits subjected to different humidities, and then placed over a desiccant for 48 hours. Desiccating tended to eliminate the effects of prior sample treatment.

24530 (CONF-9109114–Vol.1, pp. 16-23) **A comparison of energy-window and spectral-fitting methods for the estimation of carbonate content in rocks using neutron-induced gamma rays.** Hearst, J.R. (Lawrence Livermore National Lab., CA (US)); Conaway, J.G.; Trcka, D.E.; Grau, J.A. Lawrence Livermore National Lab., CA (United States). [1991]. DOE Contract W-7405-ENG-48. From 6. symposium on containment of underground nuclear explosions; Reno, NV (United States); 24-26 Sep 1991. In *Sixth symposium on containment of underground nuclear explosions: Proceedings: Volume 1.* 491p. Order Number DE92041091. Source: OSTI; NTIS (US Sales Only).

When a nuclear explosive is tested underground, rock close to the explosion is heated to very high temperatures. If any of that rock contains carbonates, these are dissociated and the carbon may combine with oxygen to form carbon dioxide. When the rock cools, the carbon dioxide remains gaseous, possibly causing subsurface pressures greater than atmospheric, which could increase the hazard of a delayed leak. To reduce that possibility, formations that might contain significant amounts of carbonates are analyzed for those materials. We have compared measurements of carbonate content from two commercial neutron-induced gamma-ray spectroscopy logging systems in emplacement boreholes at the Nevada Test Site (NTS). Both systems use high-energy neutrons to excite carbon and oxygen nuclei inelastically, and a spectrometer to detect the resulting gamma rays. One system uses broad energy windows around the main carbon and oxygen gamma-ray peaks and relates the carbonate content to the ratio of the two window count rates. This ratio requires correction for the gap between the sonde and the borehole wall, which is measured mechanically, and for the formation water content, which is obtained from a neutron log. The other system determines carbonate content by fitting the entire energy spectrum to a set of standard spectra reflecting the system response to pure elements in the formation. Water corrections are obtained directly from the spectroscopic measurements; no gap correction is needed. We tested both systems in a calibration facility to determine their responses to different values of carbonate, gap, and water content. They were then run in two boreholes at the NTS. Cuttings samples from both holes were analyzed for carbonate content for comparison with log results. After suitable averaging of both sample and log data, the two spectroscopy systems agreed with the sample carbonate contents to about 0.003 weight fraction carbon.

24531 (CONF-9109114–Vol.1, pp. 24-33) **An on-site system for scanning NTS boreholes for artificial gamma-emitting nuclides.** Conaway, J.G. (Los Alamos National Lab., NM (US)). Lawrence Livermore National Lab., CA (United States). [1991]. From 6. symposium on containment of underground nuclear explosions; Reno, NV (United States); 24-26 Sep 1991. In *Sixth symposium on containment of underground nuclear explosions: Proceedings: Volume 1.* 491p. Order Number DE92041091. Source: OSTI; NTIS (US Sales Only).

The standard spectral gamma ray logging system used at the Nevada Test Site contains a large sodium iodide detector which provides high efficiency but low energy resolution. To enhance the capabilities of this system for identifying artificial gamma-emitting nuclides, I developed and implemented a simple procedure for extracting artificial components from low-resolution gamma-ray spectra. This procedure uses three basis spectra, developed by a consultant using numerical modeling, representing the spectral response of the downhole instrument to gamma radiation from naturally occurring potassium and gamma-emitting nuclides of the uranium and thorium families in a large-diameter airfilled borehole. To extract the artificial spectral components, the three basis spectra are first scaled to the recorded field spectrum using the usual spectral windows for K, U and Th; these windows bracket the photopeaks at 1.46, 1.76 and 2.61 MeV, respectively. Since most of the contribution from artificial nuclides will fail below 1.26 MeV (the lower limit of the potassium window) this scaling process should be insensitive to the presence of artificial nuclides. The scaled basis spectra are then subtracted from the field data, leaving a residual spectrum consisting of noise plus the contribution of any artificial gamma-emitting nuclides. This process is repeated for each spectrum in the log, or the spectra can be accumulated over any desired depth range for better statistics. Rather than inspect each spectrum visually, a parameter can be computed which indicates the presence of artificial nuclides; this parameter can be plotted along with the usual K, U and Th concentration estimates as a function of depth. These techniques have been used successfully on field data and provide us with an inexpensive screening tool to detect artificial nuclides along boreholes.

24532 (CONF-9109114–Vol.1, pp. 34-59) **Application of linear inverse theory to borehole gravity data.** Burkhard, N.R. (Lawrence Livermore National Lab., CA (US)). Lawrence Livermore National Lab., CA (United States). [1991]. DOE Contract W-7405-ENG-48. From 6. symposium on containment of underground nuclear explosions; Reno, NV (United States); 24-26 Sep 1991. In *Sixth symposium on containment of underground nuclear explosions: Proceedings: Volume 1.* 491p. Order Number DE92041091. Source: OSTI; NTIS (US Sales Only).

Traditional borehole gravity interpretations are based upon an earth model which assumes horizontal, laterally infinite, uniformly thick, and constant density layers. The traditional equation used to determine density is: $\rho=1/4\pi G(F-\Delta g/\Delta z)$ where ρ is the density of a layer, F is the free-air gradient, G is the gravitational constant, and Δg is the difference in measured gravity between borehole measurement stations separated by a depth difference ΔZ. Interpretation of borehole gravity data using this equation requires that the free-air gradient be known. This approach, however does not utilize any of the advances that modern generalized linear inverse theory can bring to the problem.

24533 (CONF-9109114–Vol.1, pp. 60-97) **Formation elastic parameters from acoustic and density logs in emplacement holes.** Mathews, M.A.; Fenster, R. Lawrence Livermore National Lab., CA (United States). [1991]. From 6. symposium on containment of underground nuclear explosions; Reno, NV (United States); 24-26 Sep 1991. In *Sixth symposium on containment of underground nuclear explosions: Proceedings: Volume 1.* 491p. Order Number DE92041091. Source: OSTI; NTIS (US Sales Only).

A new acoustic tool for dry emplacement holes has been built and tested in several emplacement holes. This tool uses a large hammer source and 3 piezoelectric transducers that are independently pressed against the borehole wall. The detectors are 6, 9 and 12 ft from the hammer source. A pure gel is injected between these detectors and the borehole wall to eliminate any air space. The compressional wave travel time and the shear wave travel time are recorded at each detector. The compressional wave velocity (Vp) and the shear wave velocity (Vs) are calculated from the travel time differences between the 3 detectors and their separations of 3 and 6 ft. These velocity values along with the bulk density obtrained from the density log are used to calculate the Elastic Constants of Young's Modules, Bulk Modules, Shear Modules an Poisson's Ratio. These mechanical rock properties are presently used in phenomenological analysis and seismic verification assessment. The VD velocities obtained from the acoustic logs in U19ba and U3mt compared reasonably well with the geophone survey velocities from these emplacement holes. The only major differences occurred in the fracture intervals of U19ba where the fracture intervals were identified with the borehole camera. The geophone velocities were much less than the acoustic velocities in these fractured intervals.

24534 (CONF-9109114–Vol.1, pp. 101-115) **A new three-dimensional radiation-hydrodynamics code.** Dismukes, C.; Higginbotham, M.; Johnson, W.; Reed, L.; Shkoller, B. Lawrence Livermore National Lab., CA (United States). [1991]. From 6. symposium on containment of underground nuclear explosions; Reno, NV (United States); 24-26 Sep 1991. In *Sixth symposium on containment of underground nuclear explosions: Proceedings: Volume 1.* 491p. Order Number DE92041091. Source: OSTI; NTIS (US Sales Only).

All Defense Nuclear Agency horizontal line-of-sight (LOS) events include mechanical LOS closures to help isolate recoverable experiments and recording instruments from radioactive cavity gas. Plasma and debris jetted in the LOS ground shock closure process can severely degrade the operational effectiveness of these closures. To slow the jetted material, other mechanical items such as HE machines, mufflers, and internal helical liners are placed closer to the device to disrupt the jetted LOS flow. Some of these are known to reduce jetting but may have undesirable effects on cavity growth along the tunnel or on formation of a normal stemming plug. An attractive technique to reduce or eliminate the source of jetting LOS flow is to generate an asymmetrical closure by placing various materials in, around, and along the pipe. However, containment scientists have been reluctant to use asymmetrical configurations in part because computer simulations cannot realistically model such geometries. A numerical model has been developed to investigate the effects of asymmetries on LOS flows. A reasonable approximation of helical LOS liners is also possible. The new code, RZTSOIL, extends the two-dimensional, multi-material, axisymmetric Eulerian code, 2DSOIL, by resolving a third rotational dimension about the cylindrical axis. This three-dimensional cylindrical model is especially well suited to investigate LOS geometries because they are inherently cylindrical and the highest zonal resolution naturally occurs in the most interesting and important regions, i.e., near the LOS. RZTSOIL retains all the 2DSOIL features, including radiation diffusion, multi-material hydrodynamics, and an elastic, perfectly plastic strength model. Validating comparisons of RZTSOIL results with one- and two-dimensional calculations for simple and complex geometries are shown. Also, an initial RZTSOIL calculation of a simple asymmetric LOS closure is presented to illustrate the modeling potential.

24535 (CONF-9109114–Vol.1, pp. 116) **DISKO ELM box A environment calculations.** Dismukes, C.R. (S-Cubed, La Jolla, CA (US)); Reed, L.L.; Keller, D.J. Lawrence Livermore National Lab., CA (United States). [1991]. From 6. symposium on containment of underground nuclear explosions; Reno, NV (United States); 24-26 Sep 1991. In *Sixth symposium on containment of underground nuclear explosions: Proceedings: Volume 1.* 491p. Order Number DE92041091. Source: OSTI; NTIS (US Sales Only).

Over 20 calculations were performed to arrive at the most accurate representation of the experimental conditions involved in the hot-spot measurements at the DISCO.ELM test. The calculated radiation arrival times and pulse shapes matched closely the experimental data obtained at LANL.

24536 (CONF-9109114–Vol.1, pp. 119-140) **DISKO ELM pipe flow calculations.** Reed, L.; Keller, D.; Pierce, T.; Higginbotham, M.; Sandmann, R. Lawrence Livermore National Lab., CA (United States). [1991]. From 6. symposium on containment of underground nuclear explosions; Reno, NV (United States); 24-26 Sep 1991. In *Sixth symposium on containment of underground nuclear explosions: Proceedings: Volume 1.* 491p. Order Number DE92041091. Source: OSTI; NTIS (US Sales Only).

S-Cubed has recently developed a turbulence-ablation algorithm to improve the fidelity of modeling pipe flow in LOS design calculations. It uses the combined effect of the coefficient of friction, wall enthalpy and flow velocity to ablate the pipe wall, adding mass to the plasma and decreasing its velocity thus delaying the signal propagation along the LOS pipe. This paper describes a calculation of DISKO ELM. The calculated propagation of the pressure front along the LOS pipe is in close agreement with that inferred from the on-pipe SLIFER data. A feature of this model that may prove quite useful is that the ablation can be locally increased to simulate helix effects. In the DISKO ELM calculation, we found that increasing the coefficient of friction in the region of the "stealth helix" decreased the velocity of the pressure front in a manner qualitatively similar to that indicated on the SLIFER record. This result hints that helix effects, which have proven elusive in modeling, may be simulated as enhanced ablation. A natural consequence of "slowing" the LOS plasma flow is to increase the energy coupling from the LOS flow into the surrounding stemming. Thus, ablation may have an important role in plug formation and containment.

24537 (CONF-9109114–Vol.1, pp. 141-159) **A two-dimensional turbulence-ablation model to simulate the helix in PINEX LOS pipes.** Keller, D.; Pierce, T.; Reed, L.; Koehler, H. Lawrence Livermore National Lab., CA (United States). [1991]. From 6. symposium on containment of underground nuclear explosions; Reno, NV (United States); 24-26 Sep 1991. In *Sixth symposium on containment of underground nuclear explosions: Proceedings: Volume 1.* 491p. Order Number DE92041091. Source: OSTI; NTIS (US Sales Only).

Helices have become a common pipestring design element on PInhole Neutron EXperiments (PINEX). Despite their recognized ability to reduce pipe flow, the mechanism of their effect is not rigorously understood, although not from lack of effort. In fact, Physics International undertook an extensive HE experiment program to investigate the process, and, more recently, S-Cubed performed a related pipe flow test series. All of these experiments corroborate

the fact that pressures are greatly reduced, yet the mechanism remains elusive. In part for this reason, no credible numerical helix model has been used in LOS design calculations. The need for such a model cannot be disputed as long as these design calculations are relied upon for anticipated test behavior when helices are used. S-Cubed recently undertook an IR&D program to develop an algorithm that produces the quantitative effects of a helix according to a qualitative model. The basis of the model is the assumption that ablation is dramatically enhanced by the interaction of the pipe wall and the plasma. In effect, the helix increases the "roughness" of the pipe. The increased roughness increases the ablation of the pipe wall, which adds mass to the plasma, decreasing its velocity and increasing its pressure. The ablation rate is controlled by the model parameters coefficient of friction and wall enthalpy, and by flow velocity. The code was calibrated by comparing calculated velocity and pressure with CORRTEX data from a LANL test that featured a helix. This paper reviews our model validation calculations, demonstrating the ability of the new ablation model to simulate helix flow attenuation in a recent LLNL PINEX experiment.

24538 (CONF-9109114–Vol.1, pp. 160-195) **Plasma flow in non-circular and asymmetric pipes.** Groethe, M. (S-Cubed, La Jolla, CA (US)); Reed, L.; Keller, D.; Olsen, C. Lawrence Livermore National Lab., CA (United States). [1991]. From 6. symposium on containment of underground nuclear explosions; Reno, NV (United States); 24-26 Sep 1991. In *Sixth symposium on containment of underground nuclear explosions: Proceedings: Volume 1.* 491p. Order Number DE92041091. Source: OSTI; NTIS (US Sales Only).

S-Cubed supported LLNL in the investigation of plasma flow in LOS pipes of various non-standard geometries. Novel approaches were sought to achieve both experiment and containment objectives in a conceptual high-yield vertical LOS test. Part of our program was a series of scaled HE pipe flow experiments, which are the subject of this paper. Flow diagnostics from the experiments confirmed our hypothesis that a "low-flow" pipe could be designed by increasing its asymmetry. In all, five pipe flow experiments were performed. Each was driven with a standard five-pound HE charge that was designed to implode symmetrically, crushing the LOS pipe. The cross-sectional area and thickness of the pipes were impulse-scaled to nuclear LOS pipe areas. The following pipe definitions were tested: (1) circular, as a baseline or standard; (2) oval, as a test of axial asymmetry; (3) rectangular, as an approximation of collapsing plates; (4) rectangular, with opposite walls of differing thickness as a test of mass-asymmetric collapsing plates; (5) rectangular, with opposite walls of differing thickness and stagnation strips, to provide asymmetry and disrupt the laminar flow. In all cases, the measured flow comprised two phases or pulses. Generally, first-pulse flow velocities were found to be sensitive to vacuum conditions inside the pipe, while the second-pulse showed greater geometry sensitivity. The effects of geometry were dramatic: Stagnation pressures associated with the second-pulse were reduced by a factor of 45 from most to least symmetric flow region.

24539 (CONF-9109114–Vol.1, pp. 199-207) **Effective stress model for rocks.** Dey, T.N. (Los Alamos National Lab., NM (US)). Lawrence Livermore National Lab., CA (United States). [1991]. From 6. symposium on containment of underground nuclear explosions; Reno, NV (United States); 24-26 Sep 1991. In *Sixth symposium on containment of underground nuclear explosions: Proceedings: Volume 1.* 491p. Order Number DE92041091. Source: OSTI; NTIS (US Sales Only).

An effective stress model, which has been implemented into a finite difference code suitable for containment calculations, is described. The model captures the well understood effects of pore pressure on shear strength and pore crushing. The model also incorporates work hardening and softening and a number of flow rules. Two examples illustrate some of the consequences of the effective stress model, including a decrease in shear strength during unloading, and liquefaction.

24540 (CONF-9109114–Vol.1, pp. 208-225) **Sensitivities of calculated residual stress to separation distances of two simultaneous events.** Rambo, J.T. (Lawrence Livermore National Lab. CA (US)); Moss, W.C. Lawrence Livermore National Lab., CA (United States). [1991]. From 6. symposium on containment of underground nuclear explosions; Reno, NV (United States); 24-26 Sep 1991. In *Sixth symposium on containment of underground nuclear explosions: Proceedings: Volume 1.* 491p. Order Number DE92041091. Source: OSTI; NTIS (US Sales Only).

LLNL has developed calculational capabilities to model simultaneous explosions of different yields with DYNA2D. Past experimental experience suggests that double events are contained when the work points are separated by no less than twice the sum of the final radii of the two cavities with the higher yield device buried at a safe depth and above the lower yield device. In the past, this non-optimal use of the drill hole was chosen to ensure safe containment and to provide cost savings. Although additional savings can be realized by placing the lower yield device above the higher yield device, there is no really relevant experimental experience. Given current and projected funding levels for the nuclear testing program, study (calculationally) of the feasibility of a low-overhigh emplacement could make possible significant savings. In this study we examine the sensitivity of the residual stress field to work point separation for a one kiloton device placed above a ten kiloton device. The geometry is cylindrically symmetric. Work point separations were varied between 50 and 300 m. The depth of burial for the upper device was fixed at 270 m so that overburden would not be a sensitivity factor in the residual stress calculation.

24541 (CONF-9109114–Vol.1, pp. 229-253) **Containment phenomenology using a new shear-strain-based computational damage model for TUFF.** Rimer, N. (S-Cubed, La Jolla, CA (US)); Proffer, W. Lawrence Livermore National Lab., CA (United States). [1991]. From 6. symposium on containment of underground nuclear explosions; Reno, NV (United States); 24-26 Sep 1991. In *Sixth symposium on containment of underground nuclear explosions: Proceedings: Volume 1.* 491p. Order Number DE92041091. Source: OSTI; NTIS (US Sales Only).

This paper presents the results of a series of spherically symmetric free-field ground motion calculations made using a new constitutive model for the damage assumed to occur in zeolitized tuff as a result of a nuclear explosion. The major difference in this damage model is that the transition between the "virgin" failure surface and the lower "damaged" strength after shock passage is based now upon the maximum shear strain recorded in the tuff element during the calculation rather than upon the peak volumetric strain used in older damage models. For the new model, the damaged strengths are obtained from the results of laboratory material properties tests on core samples of tuff which have been removed from near the cavity produced by the nuclear event. These tests show much lower strengths at confining pressures on the order of one kilobar than are shown in the standard "laboratory damage" tests in which virgin core samples are damaged using a uniaxial strain loading to a peak stress of 4 kb followed by a biaxial strain unload. Use of the new damage model did not change the calculated peak stresses, peak particle velocities, and cavity size which are in agreement with the usual ground motion measurements. Thus, the phenomenology and the constitutive models are not sufficiently constrained by the types of laboratory damage measurements presently being made. In the absence of experimental confirmation of the magnitude of the residual stress fields around a nuclear cavity, better material properties data are clearly needed to constrain these constitutive models that are used to calculate the grout stemming motions in horizontal line-of-sight (HLOS) events.

24542 (CONF-9109114–Vol.1, pp. 254) **Calculations of ground motion on Pahute Mesa.** App, F.N. (Los Alamos National Lab., NM (US)); Brunish, W.M. Lawrence Livermore National Lab., CA (United States). [1991]. From 6. symposium on containment of underground nuclear explosions; Reno, NV (United States); 24-26 Sep 1991. In *Sixth symposium on containment of underground nuclear explosions: Proceedings: Volume 1.* 491p. Order Number DE92041091. Source: OSTI; NTIS (US Sales Only).

The ground motion in the overburden sections of dense tuffs and lavas was studied by calculation. It was indicated that the dense layers are significantly more compressible and prone to shear failure than implied by tests on the core; this might be due to fractures in the hard rocks on Palute Mesa. It is believed that the gauges reflect accurately the motion of the rock mass.

24543 (CONF-9109114–Vol.1, pp. 257-274) **Thermodynamic evolution of nuclear cavities.** Peterson, E. (S-Cubed, La Jolla,

CA (US)); Lie, K.; Rimer, N.; Nilson, R.; Higgins, G. Lawrence Livermore National Lab., CA (United States). [1991]. From 6. symposium on containment of underground nuclear explosions; Reno, NV (United States); 24-26 Sep 1991. In *Sixth symposium on containment of underground nuclear explosions: Proceedings: Volume 1.* 491p. Order Number DE92041091. Source: OSTI; NTIS (US Sales Only).

The cavity pressure history of an underground nuclear explosion is of critical importance in nearly all aspects of containment phenomenology and engineering. During the dynamic ground motion phase of an event, the variation of pressure with cavity volume is important in determining the fraction of the device energy which is coupled to the ground and, ultimately, the final volume and associated equilibrium pressure of the cavity. At later times, the cavity pressure gradually decreases as the energy is radiated from the cavity gas to the cooler rock walls, causing ablation of wall material and heat loss to the surroundings. Throughout both of these periods, early and late, the cavity pressure is the primary force which drives the gas leakage that we seek to contain. The thermodynamic evolution of the cavity is strongly influenced by the amount of material which is mixed into the cavity by (1) early-time stress release subsequent to shock loading and (2) late-time thermal ablation of wall material. Through post-processing of ground motion calculations under different suppositions concerning thermal equilibrium within the cavity, it is estimated that although thermally-induced mixing might eventually envelop as much as 2700 Mg/kt, early-time stress unloading should release no more than 500 Mg/kt into the cavity. To explore the effect of early-time material mixing on quantities of containment interest, ground motion calculations are executed with a gradual release of mass into the cavity on a time scale consistent with shock loading and unloading of the added material. The results indicate that the time and amount of mixing has an important influence on the late-time cavity pressure, even though the effect on ground motion is nearly undetectable. Additional parameter studies illustrate the variations in cavity pressure and ground motion caused by variations in rock strength, water content, air void, and equation of state.

24544 (CONF-9109114–Vol.1, pp. 275-290) **Cavity pressure measurements on DISKO ELM.** Hudson, B.; Stubbs, T. Lawrence Livermore National Lab., CA (United States). [1991]. DOE Contract W-7405-ENG-48. From 6. symposium on containment of underground nuclear explosions; Reno, NV (United States); 24-26 Sep 1991. In *Sixth symposium on containment of underground nuclear explosions: Proceedings: Volume 1.* 491p. Order Number DE92041091. Source: OSTI; NTIS (US Sales Only).

Cavity pressure measurements were made on the DISKO ELM event using six stainless steel, pressurized, capillary tubes extending from the working point region to an alcove in the by-pass drift. Each pressure measurement system included two pressure transducers in the alcove and one in the stemming on the working point side of three check valves. Three water-filled tubes were pressurized to about 5000 psia before zero time with the full nitrogen-filled volume of the pressure tank. Two water-filled tubes were pressurized before zero time with essentially zero driving gas volume. The sixth tube was nitrogen-filled. The purpose of these measurements was to gain some knowledge concerning the performance of various measurement configurations as well as to obtain a cavity pressure history for DISKO ELM. Sixteen of the 18 pressure transducers appear to have given good data. The tubes that remained liquid-filled came into equilibrium with the cavity pressure first (about one minute). Data from the air-filled tube suggest blockage until collapse at about 2 h. The pressure transducers on the working point side of the check valves appear to be the most representative of cavity pressure. Four tubes (12 pressure transducers) gave very similar results from about 3 min until collapse at about 28 h. A comparison of the data from Rhyolite, Cornucopia, and Mission Ghost supports the conclusion that the DISKO ELM data are representative of cavity pressure.

24545 (CONF-9109114–Vol.1, pp. 291-310) **Dalhart post shot investigation.** Mathews, M.A. (Los Alamos National Lab., NM (US)); Hahn, K.; Thompson, J.; Gadeken, L.; Madigan, W. Lawrence Livermore National Lab., CA (United States). [1991]. From 6. symposium on containment of underground nuclear explosions; Reno, NV (United States); 24-26 Sep 1991. In *Sixth symposium on containment of underground nuclear explosions: Proceedings: Volume 1.* 491p. Order Number DE92041091. Source: OSTI; NTIS (US Sales Only).

Multiple radioactive isotopes tracers are used in borehole operations in the petroleum industry and these tracers are monitored by gamma ray spectroscopy logging tools. The nuclear test DALHART, U4u, was executed at a depth of 2100 ft on October 13, 1988. This test has multiple radioactive isotopes or fission products associated with it and knowledge of the distribution of these isotopes is desirable for the Nuclear Test Program. A slant post shot hole was drilled in late August, 1990 to sample the geologic material from the collapsed zone or chimney above DALHART. This 9 7/8 inch borehole was drilled at approximately 19 degrees from the vertical toward the DALHART execution depth. This borehole started at approximately 734 ft due south of the DALHART event. Drilling was completed to 2280 ft (2156 ft TVD). The water level was encountered at a depth of 1741 ft (1644 ft TVD). A Halliburton 1 11/16 in diameter TracerScan gamma-ray-spectroscopy log was run inside the drill string at a speed of 10 ft/min. Spectra obtained from TD to the surface indicated that radioactive material produced by the test was present from TD to 1850 ft (1746 ft TVD). Spectra were acquired at 0.25 ft depth intervals and averages recorded digitally every ten ft and thirty ft were displayed on the blue line log together with the total observed gamma ray and casing collar locater signal. Eleven samples were acquired from the depth interval 2212 ft to 1823 ft (2089 to 1721 ft TVD). None of these samples contained enough activity to be measured with normal drillback survey instruments. An onsite intrinsic Ge detector showed that each sample contained ^{137}CS, ^{125}Sb and ^{106}Ru. The samples were sent to Los Alamos to determine the radionuclide content at each depth. These analyses were compared with the spectral data obtained from the spectroscopy log and radionuclide distribution was mapped.

24546 (CONF-9109114–Vol.1, pp. 311-315) **Cavity collapse safety system.** Deupree, R.G. (Los Alamos National Lab., NM (US)); Neergaard, J.R.; Turner, W.J. Lawrence Livermore National Lab., CA (United States). [1991]. From 6. symposium on containment of underground nuclear explosions; Reno, NV (United States); 24-26 Sep 1991. In *Sixth symposium on containment of underground nuclear explosions: Proceedings: Volume 1.* 491p. Order Number DE92041091. Source: OSTI; NTIS (US Sales Only).

The EXCOR time domain reflectometer has been used to determine cavity collapse properties on Los Alamos nuclear weapons tests for several years. We have now extended the system to provide warning for data recovery teams in the trailers that cavity collapse has begun to take place. This new approach is far more reliable than the previous practice of examining geophone traces.

24547 (CONF-9109114–Vol.1, pp. 319-358) **RAMS data for selected LANL events.** Trent, B.C. (Los Alamos National Lab., NM (US)); Marusak, N.L. Lawrence Livermore National Lab., CA (United States). [1991]. From 6. symposium on containment of underground nuclear explosions; Reno, NV (United States); 24-26 Sep 1991. In *Sixth symposium on containment of underground nuclear explosions: Proceedings: Volume 1.* 491p. Order Number DE92041091. Source: OSTI; NTIS (US Sales Only).

Data from downhole RAMS (remote area monitoring station) packages have been compiled for several LANL events. We are making this data easily available so that a more effective analysis can be made of the performance of LANL emplacement design. For each event, general information is available such as hole designator, number and location of RAMS packages fielded and other information such as cavity collapse time and some specific radiation history data. The actual curves plotted for a given event might include the low and/or high pressure record(s), the radiation time history and the measured acceleration, depending on the availability and readability of the RAMS unit. Although some components of these data have been presented elsewhere, the actual curves (especially the pressure records) have not been previously available.

24548 (CONF-9109114–Vol.1, pp. 359-375) **Field measurements of tracer gas transport induced by barometric pumping.** Nilson, R.H. (S-Cubed, La Jolla, CA (US)); Lagus, P.L.; McKinnis,

W.B.; Hearst, J.R.; Burkhard, N.R.; Smith, C.F. Lawrence Livermore National Lab., CA (United States). [1991]. DOE Contract W-7405-ENG-48. From 6. symposium on containment of underground nuclear explosions; Reno, NV (United States); 24-26 Sep 1991. In *Sixth symposium on containment of underground nuclear explosions: Proceedings: Volume 1.* 491p. Order Number DE92041091. Source: OSTI; NTIS (US Sales Only).

Vertical gas motions induced by barometric pressure variations can carry radioactive gases out of the rubblized region produced by an underground nuclear explosion, through the overburden rock, into the atmosphere. To better quantify the transit time and amount of transport, field experiments are being conducted at two sites on Pahute Mesa, and Kapelli Tierra, where radioactive gases have been earlier detected in surface cracks. At each site, two tracer gases are injected into the rubblized chimney 300-400 m beneath the surface and their arrival is monitored by concentration measurements in gas samples extracted from shallow collection holes and tented areas located near surface cracks. The first "active" tracer is driven by a large quantity of injected air, the second "passive" tracer is introduced with minimal gas drive to observe the natural transport by barometric pumping. Kapelli was injected over a year ago, whereas Tierra was injected just recently. At both Kapelli and Tierra, no surface arrival of tracer was observed during the active phase of the experiment despite the injection of several million cubic feet of air, suggesting that cavity pressurization is likely to induce horizontal transport along high permeability layers, rather than vertical transport to the surface. Soon thereafter, a quasisteady pumping regime was established, with tracer concentrations in effluent gases typically 1000 times smaller than concentrations thought to exist in the chimney. Comparison of this thousand-fold dilution with theoretical calculations indicates that the prominent surface crack at Kapelli is not, by itself, the primary breathing passage of the chimney, but rather that there are likely to be many more cracks, spaced several meters apart, having comparable transport but less obvious surface expression.

24549 (CONF-9109114–Vol.1, pp. 376-398) **Parametric studies of gas flow in LLNL and LANL stemming.** Trent, B.C. (Los Alamos National Lab., NM (US)). Lawrence Livermore National Lab., CA (United States). [1991]. From 6. symposium on containment of underground nuclear explosions; Reno, NV (United States); 24-26 Sep 1991. In *Sixth symposium on containment of underground nuclear explosions: Proceedings: Volume 1.* 491p. Order Number DE92041091. Source: OSTI; NTIS (US Sales Only).

Fairly high levels of radiation were detected relatively high in the hole for the LLNL Barnwell event at relatively early times. In an effort to understand the phenomenology of such transport, an extensive array of gas flow calculations was performed. After 21 calculations, reasonable agreement was achieved with the pressure and radiation records at all the elevations in terms of magnitude, shape of the curves and time-of-arrival. The results indicate that for this event, which is not typical of LLNL stemming performance, there was fairly high permeability (100 darcy) flow through (or around) the lower four SGC plugs, high permeability (10 to 20 darcy) in the upper formation (above 384 m), and a reasonably high cavity pressure (134 bars) with slow decay. These same boundary conditions and formation properties were used to drive gas through typical LANL stemming, i.e. alternating layers of coarse and fines. The results of those calculations indicated lower magnitudes and later arrivals of radiation and pressure, particularly for the case where the fines were assumed to have been compacted to a lower permeability within the 1 kbar stress region.

24550 (CONF-9109114–Vol.1, pp. 399-411) **Sustained growth of multiple gas-driven fractures.** Nilson, R.H. (S-Cubed, La Jolla, CA (US)); Halda, E.J.; Griffiths, S.K. Lawrence Livermore National Lab., CA (United States). [1991]. From 6. symposium on containment of underground nuclear explosions; Reno, NV (United States); 24-26 Sep 1991. In *Sixth symposium on containment of underground nuclear explosions: Proceedings: Volume 1.* 491p. Order Number DE92041091. Source: OSTI; NTIS (US Sales Only).

The long-range extension of a single hydrofracture is frequently considered as a possible threat to the containment of an underground nuclear test. However, the results of explosively driven field experiments, like Sandia's junior jade series, suggest that conditions strongly favoring hydrofracture are likely to produce several fractures of moderate length rather than a single one of excessive length. Improved understanding of multifracture phenomena should, therefore, lead to a more realistic assessment of the hydrofracture threat and perhaps a better understanding of fragmentation, energy dispersal, and material mixing. In particular, the present paper seeks to define the conditions necessary for sustained propagation of multiple fractures. Multiple fractures emanating from a common source compete with one another because an increase in the aperture of any one crack increases the compressive stress on its neighbors, reducing their apertures. Furthermore, since a larger aperture will generally increase the speed of driving gases, a wider crack will elongate faster than its counterparts, further increasing its aperture and speed at their expense. So a fracture which gains a slight advantage will rapidly squelch its neighbors whenever fracture growth rates are limited by frictional effects in the driving gasses. However, it should be possible to sustain the growth of multiple fractures if the driving gas pressure is great enough to drive them all at the so-called "terminal" speed which is controlled by inertial and/or micromechanical affects occurring within the rock. Similarly, it may also be sufficient that the driving pressure be large enough to sustain choked flow at the inlets to all of the cracks. Under either of these conditions, fracture speeds become less sensitive to aperture and length, thereby disabling the fracture-competition mechanism which would otherwise prevent the long-range extension of multiple fractures.

24551 (CONF-9109114–Vol.1, pp. 412-449) **Gas flow calculations and measurements for the Ledoux event.** Trent, B.C. (Los Alamos National Lab., NM (US)); Lowry, W.E. Lawrence Livermore National Lab., CA (United States). [1991]. From 6. symposium on containment of underground nuclear explosions; Reno, NV (United States); 24-26 Sep 1991. In *Sixth symposium on containment of underground nuclear explosions: Proceedings: Volume 1.* 491p. Order Number DE92041091. Source: OSTI; NTIS (US Sales Only).

In addition to the standard pressure and radiation measurements made in the stemming materials, gas pressure measurements were also made in the diagnostic drift (in communication with the zero room) and in specially drilled holes adjacent to the main drift. The results of these measurements ranged from excellent to very limited knowledge gained. The results are presented along with recommendations for improved design for future experiments. The purpose of making such measurements is to help validate porous flow calculations. Extensive pre-shot gas flow and radiation transport calculations were performed, and the results are compared to the actual data.

24552 (ORNL/Sub–91-SG105/1) **HEMP emergency planning and operating procedures for electric power systems: Power Systems Technology Program.** Reddoch, T.W. (Electrotek Concepts, Inc., Knoxville, TN (United States)); Markel, L.C. Oak Ridge National Lab., TN (United States); Electrotek Concepts, Inc., Knoxville, TN (United States). [1991]. 97p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93012094. Source: OSTI; NTIS; GPO Dep.

Investigations of the impact of high-altitude electromagnetic pulse (HEMP) on electric power systems and electrical equipment have revealed that HEMP creates both misoperation and failures. These events result from both the early time E_1 (steep-front pulse) component and the late time E_3 (geomagnetic perturbations) component of HEMP. In this report a HEMP event is viewed in terms of its marginal impact over classical power system disturbances by considering the unique properties and consequences of HEMP. This report focuses on system-wide electrical component failures and their potential consequences from HEMP. In particular, the effectiveness of planning and operating procedures for electric systems is evaluated while under the influence of HEMP. This assessment relies on published data and characterizes utilities using the North American Electric Reliability Council's regions and guidelines to model electric power system planning and operations. Key issues addressed by the report include how electric power systems are affected by HEMP and what actions electric utilities can initiate to reduce the consequences of HEMP. The report also reviews the salient features of earlier HEMP studies and projects, examines

technology trends in the electric power industry which are affected by HEMP, characterizes the vulnerability of power systems to HEMP, and explores the capability of electric systems to recover from a HEMP event.

24553 (SAND–93-0368) **Estimation of partial decoupling of cavity events.** Garbin, H.D. Sandia National Labs., Albuquerque, NM (United States). Mar 1993. 22p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. Order Number DE93012439. Source: OSTI; NTIS; GPO Dep.

One proven method of evading the detection of a nuclear test is to decouple the explosion with a large air-filled cavity. Past tests have shown it is possible to substantially reduce the seismic energy emanating from a nuclear explosion by as much as two, orders of magnitude. The problem is not whether it can be done; the problem is the expense involved in mining a large cavity to fully decouple any reasonable size test. It has been suggested that partial decoupling may exist so some fraction of decoupling may be attained between factors of 1 to 100. MISTY ECHO and MINERAL QUARRY are two nuclear tests which were instrumented to look at this concept. MISTY ECHO was a nuclear explosion conducted in an 11 m hemispherical cavity such that the walls were over driven and reacted in a non-linear manner. MINERAL QUARRY was a nearby tamped event that is used as a reference to compare with MISTY ECHO. The scaled cavity radius of MISTY ECHO was greater than $2m/kt^{1/3}$. Both of these tests had free-field accelerometers located within 400 m of their respective sources. Analysis of surface ground motion is inconclusive on the question of partial decoupling. This is due to the difference in medium properties that the ray paths take to the surface. The free-field configuration alleviates this concern. The analysis consists of cube-root signal MINERAL QUARRYs signal to MISTY ECHO's yield and calculating the ratio of the Fourier amplitudes of both the acceleration and the reduced displacement potentials. The results do not indicate the presence of partial decoupling. In fact, there is a coupling enhancement factor of 2.

24554 (SAND–93-0738) **Defense Programs: A Sandia weapon review bulletin, Winter 1993.** Floyd, H.L.; Goetsch, B.; Doran, L. (eds.). Sandia National Labs., Albuquerque, NM (United States). [1993]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. Order Number DE93013496. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This bulletin describes current efforts at Sandia National Laboratory to assist the US DOE defense programs. Topics in this issue include: compact electronic power circuits, stockpile stewardship, the SafeGuards transporter, laser diode ignition systems, an examination of the threat of nuclear weapon theft, and nuclear weapons testing.

24555 (UCRL-ID–112735) **A magnetically contained Mach three expansion.** Simonson, G.F.; Byers, J.A.; DiPeso, G.J.; Hewett, D.W.; Shumaker, D.E. Lawrence Livermore National Lab., CA (United States). Jan 1993. 82p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE93013935. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The expansion of debris from a high altitude nuclear explosion (HANE) and its interaction with the geomagnetic field and ambient atmosphere have been calculated with a two-dimensional hybrid particle-in-cell (PIC) code. This work is distinct from the authors' previous simulations of detonations at very high altitude (VHANE) in that the surrounding air ion density is much increased and the air now plays a significant role in the dynamics of the expansion. The mean debris expansion velocity is 1,500 km/s, as in previous VHANE calculations, but the Alfven velocity in undisturbed air is now only 500 km/s, providing a Mach three expansion. The maximum distance over which weapon debris is dispersed, and the diamagnetic cavity radius, are considerably smaller than for a VHANE of like yield. The standard scaling of bubble radius with kinetic yield and field strength does not apply.

24556 (UCRL-JC–108751) **Fiber-optic cable replacement for NTS applications.** Sargis, P.D. Lawrence Livermore National Lab., CA (United States). Nov 1991. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-920367–9: Department of Defense (DOD) fiber optics conference, McLean, VA (United States), 25 Mar 1992). Order Number DE93012548. Source: OSTI; NTIS; GPO Dep.

Coaxial cables are gradually beinq replaced by analog fiber-optic links at the Nevada Test Site. The capabilities of two recently developed systems will be discussed.

24557 (UCRL-JC–111562) **Interactions between shocks and turbulence: Large eddy simulations.** Buckingham, A.C. Lawrence Livermore National Lab., CA (United States). Nov 1992. 32p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9211128–9: 1992 nuclear explosives code developers conference, Sunnyvale, CA (United States), 2-6 Nov 1992). Order Number DE93013352. Source: OSTI; NTIS; GPO Dep.

When a shock moves into and interacts with an existing turbulent field, a substantial enhancement of the after-shock turbulent intensity and a simultaneous distortion and realignment of the tensor strain rate field and associated tensor stress field results. Component mixing, random advective transport, and diffusion and associated momentum and energy dissipation are often substantially intensified over their preshocked levels. A combination of low preshocked turbulent intensity and strong shocks evidently produces the most pronounced change in the level of turbulent intensity. Combinations of high preshocked turbulent intensity and weaker shocks result in more modest changes to the turbulent field but much more pronounced dynamical distortion and erratic motion of the shock front itself during the interaction. Recent experimental observations suggest that substantial turbulent intensification and pronounced shock front distortion persists even for shocks propagating at Mach numbers in excess of 100. This discussion investigates the physics of the interaction process using numerical simulations to supplement and analyze the existing experimental data base. Use has been made of direct two dimensional Monte Carlo simulations to examine the influence of upstream turbulence on shock structure and front topography. Linear viscoelastic turbulence response parameters were developed in modeling the interaction. Compressible, two-dimensional large eddy simulations (LES) have been applied. Predicted amplification levels, modal energy partition, shock translational to turbulence kinetic energy transfer, and viscoelastic response of turbulence to shock interaction are examined in comparison with available experimental evidence. Developments in two-band dynamic eddy viscosity modeling for the subgrid scales are being implemented to improve results of the LES in the near wall region, under the influence of stochastic subgrid scale backscatter, and near the shock.

4503 Nuclear Explosion Detection

Refer also to citation(s) 24487

4504 Nuclear and Radiological Warfare

Refer also to citation(s) 23886

4505 Strategic Defense Initiative

24558 (DNA-TR–92-131) **Validation of survivability validation protocols.** Stringer, T.A. (Kaman Sciences Corp., Colorado Springs, CO (United States)). Defense Nuclear Agency, Alexandria, VA (United States); Kaman Sciences Corp., Colorado Springs, CO (United States). May 1993. 18p. Sponsored by Department of Defense, Washington, DC (United States). Contract DNA 001-89-C-0080. Order Number DE93013096. Source: OSTI; NTIS.

Issues associated with the validation of survivability protocols are discussed. Both empirical and analytical approaches to protocol validation are included. The use of hybrid simulations (hardware-in-the-loop, scene generators, software generators, man-in-the-loop, etc.) for the validation of survivability protocols is discussed.

24559 (LA–12450-MS) **Comments on "global defense and strategic stability".** Canavan, G.H. Los Alamos National Lab., NM (United States). Apr 1993. 18p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. Order Number DE93013594. Source: OSTI; NTIS; GPO Dep.

Recent Russian publications are used to explore disagreements over the stability characteristics of the regime we are leaving and the one we want to enter. Doing so gives a clear picture of how stability issues are quantified in current Russian thinking, what their main conclusions are, and how they serve as a guide to Former Soviet Republics thinking in moving towards this new world order. It demonstrates the convergence of exchange calculations and gives a prescription for connecting the results of US and Russian stability metrics, which could open the way for more fruitful discussions of the joint pursuit of offensive reductions and defenses.

24560 (LA–12489-MS) **Fast interceptors for theater boost-phase intercept.** Canavan, G.H. Los Alamos National Lab., NM (United States). Apr 1993. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. Order Number DE93013596. Source: OSTI; NTIS; GPO Dep.

Boost-phase theater intercept concepts are needed for known and existing countermeasures to current systems. Fast kinetic energy interceptors could be developed from existing and improved propulsion technology and miniaturized sensors to provide that capability. High velocity interceptors with achievable acceleration could achieve the ranges needed for protection of bases and populations, addressing most theater threats. Propulsion requires development. Drag and heating are largely predictable and controllable. Fast interceptors would also have useful applications in national and global missile defense.

24561 (UCRL-ID–109792) **Spacecraft Fabrication and Test MODIL: Quarterly report, December 1991–February 1992.** Saito, T.T.; Spellman, G.P.; Sanders, D.M.; Griffith, L.V.; Cruz, G.E. Lawrence Livermore National Lab., CA (United States). May 1992. 25p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE93012392. Source: OSTI; NTIS; GPO Dep.

MODILs (Manufacturing Operations and Development Integration Laboratories) wert established to mitigate the risk and cost escalation of producing SDI systems. The Spacecraft Fabrication and Test (SF&T) MODIL was first proposed by the Lawrence Livermore National Laboratory in February of 1991 and was initiated in late November 1991 with an initial funding of $2.0 M from the Department of Defense MANTECH program. The DoD focal point has been Mr. Greg Stottlemyer of SDI's Systems Integration and Command and Control office. The SF&T MODIL has been established to improve spacecraft producibility and create a spacecraft industry quantity production culture. We describe the background of MODILs, objectives and scope, current organization (including cooperating government agencies), and the current thrusts of Materials and Structures, Test and Assembly, Spacecraft Integration Technology, and Precision Technologies. We are preparing to participate in the Producible Technology Working Groups (PTWGs) being established by SDIO. The current plan is to initiate selected productivity demonstration projects with industry to show the benefits of the MODIL approach and prepare comprehensive plans for follow-up activities. Some major conclusions from this quarter are: The top producibility issues varied between SDIO contractors; Producibility issues must be re-prioritized based on changing mission requirements; and MODEL future success depends on addressing producibility issues that are important to SDIO Program offices. The whole-hearted concurrence of the contractor that will insert the production technology is required.

24562 (UCRL-JC–110271) **Spacecraft Fabrication and Test Manufacturing Operations and Development Integration Laboratory (MODIL): Establishing a spacecraft fabrication culture.** Saito, T.T. (Lawrence Livermore National Lab., CA (United States)); Sanders, D.M.; Stowers, I; Aswani, M. Lawrence Livermore National Lab., CA (United States). Apr 1992. 8p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-920471–7: International Society for Photo Optical Engineering (SPIE) conference, Orlando, FL (United States), 20-24 Apr 1992). Order Number DE93012494. Source: OSTI; NTIS; GPO Dep.

MODILs (Manufacturing Operations and Development Integration Laboratory) were established to mitigate risk and cost escalation of producing SDI systems. The Spacecraft Fabrication and Test MODIL has been established to impact spacecraft producibility and create a spacecraft industry quantity production culture. We describe the background of MODILS, objectives and scope, current organization (including cooperating government agencies), and the current thrusts of Materials and Structures, Test and Assembly, Spacecraft Integration Technology, and Precision Technologies. The current plan is to initiate selected productivity demonstration projects with industry to show benefits of the MODIL approach and prepare comprehensive plans for follow-up activities.

24563 (UCRL-JC–110272) **Cryocooler producibility, within a MODIL concept.** Cruz, G.E. (Lawrence Livermore National Lab., CA (United States)); Saito, T.T.; Fehrenbacher, L. Lawrence Livermore National Lab., CA (United States). Apr 1992. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9204112–4: 2. small satellite technology and applications, Orlando, FL (United States), 20-24 Apr 1992). Order Number DE93012493. Source: OSTI; NTIS; GPO Dep.

Cryocoolers are a key component for many spacecraft. We summarize some spacecraft cryocooler requirements and discuss our observations regarding the current production capabilities of cryocoolers. The MODILs interaction with industry, especially through the Producible Technology Working Groups is also summarized. The current Spacecraft Fabrication and Test MODIIL's plans to improve producibility include working closely with industry, executing a demonstration project, and holding a workshop to bring key members of the current cryocooler development network together.

4506 Chemical and Biological

24564 (UCRL-ID–111403) **Neutralization of chemical/biological ballistic warheads by low-yield nuclear interceptors.** Kruger, H.; Mendelsohn, E. Lawrence Livermore National Lab., CA (United States). 6 Aug 1992. 28p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE93012445. Source: OSTI; NTIS; GPO Dep.

We have investigated the capability of low-yield nuclear interceptors to neutralize chemical or biological tactical ballistic missile warheads using our TART coupled neutron-gamma Monte Carlo radiation transport code. In these calculations we used the neutron and gamma output spectra of a generic fission or fusion interceptor warhead and a generic chemical/biological warhead model. We made estimates of radiationneutralization criteria for biological organisms, biologically derived toxins, and chemical agents. We stipulated an interceptor miss distance of the order of one meter. Using these criteria, we find that a 100ton fission yield will neutralize the biological agent in all submunitions at an intercept distance of three meters. Neutralization of the chemical agent at this distance will require a fission yield of a few kilotons. This task can be accomplished with a fusion yield of only 100 tons. We would also expect 100 tons of either fission or fusion yield to neutralize unarmed or armed tactical ballistic missile nuclear warheads at a three meter miss distance by vaporization of fissile materials. Thus, we believe that a low-yield nuclear interceptor offers a defense capable of neutralizing tactical ballistic missiles carrying anyone of the three classes of mass-destruction warheads.

24565 (UCRL-ID–112014) **Neutron shielding of chemical/biological warheads to minimize the effects from low-yield nuclear interceptors.** Mendelsohn, E. Lawrence Livermore National Lab., CA (United States). Oct 1992. 24p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE93013101. Source: OSTI; NTIS (US Sales Only); GPO Dep.

We have previously reported results of Monte Carlo calculations in which we utilized the penetrating radiation from a small nuclear warhead to produce damaging energy deposition in chemical and biological warheads containing toxic agents. In the present work we have extended that study to include the effects of substantial neutron shielding on such energy deposition. This assumes that an attacker is willing to suffer a large payload penalty to assure the survival of a few submunitions elements. Our results show that there is a significant benefit from such a trade-off only for a fission source. For a fusion source the energy deposition in the shielded submunitions is approximately the same as in submunitions with the lowest energy deposition in the unshielded warhead.

54 ENVIRONMENTAL SCIENCES

Refer also to citation(s) 24478, 24943, 25455

24566 (Juel–2691) **Contributions to the environmental specimen bank. Pt. 8. Analysis of the concentration-time characteristics of selected sewage sludge constituents - derivation of a sampling strategy for representative sewage sludge specimens.** Osberghaus, U. (Analytisches Labor, Aachen (Germany)); Grimmer, G.; Stoeppler, M. Forschungszentrum Juelich GmbH (Germany). Inst. fuer Chemie 4 - Angewandte Physikalische Chemie. Nov 1992. 184p. (In German). Order Number DE93792712. Source: OSTI; NTIS (US Sales Only).

Sewage sludge samples were taken from nine differently sized sewage treatment plants at monthly intervals. The samples were analyzed for dry residues, residues on ignition, 7 heavy metal components and 15 polycyclic aromatic hydrocarbons. Assuming a normal data distribution each concentration-time sequence was assigned a coefficient of variation for determination of the variance of distribution, and the sample size, which must be known for the purpose of representative sampling, was calculated for a statistical confidence level of 90%. (orig.).

24567 (ORNL–6733) **Environmental Sciences Division annual progress report for period ending September 30, 1992.** Oak Ridge National Lab., TN (United States). Apr 1993. 287p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93013865. Source: OSTI; NTIS; INIS; GPO Dep.

Environmental Sciences Division Publication No. 4034.

This progress report summarizes the research and development activities conducted in the Environmental Sciences Division of Oak Ridge National Laboratory during fiscal year (FY) 1992, which which extended from October 1, 1991, through September 30, 1992. This report is structured to provide descriptions of current activities and accomplishments in each of the division's major organizational units. Section activities are described in the Earth and Atmospheric sciences, ecosystem studies, Environmental analysis, environmental biotechnology, and division operations.

5401 Environmental Sciences, Atmospheric

Refer also to citation(s) 22751, 22830, 22843, 22844, 22868, 22915, 22985, 23045, 23060, 23091, 23147, 23305, 23336, 23349, 23351, 23544, 23730, 23733, 23737, 23738, 23739, 23744, 23795, 23811, 23832, 23842, 23875, 23877, 23878, 24058, 24100, 24266, 24555, 24666, 24667, 24668, 24700, 24702, 24750, 24762, 24771, 24776, 24804, 24831, 24894, 24901, 24906, 24907, 24947, 24965

24568 (BNL–70246) **[Gathering and exchange information on atmospheric chemistry and polluted atmospheres]: Foreign trip report, July 15–August 5, 1992.** Newman, L. Brookhaven National Lab., Upton, NY (United States). 30 Oct 1992. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. Order Number DE93009940. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Detailed examination and information was obtained on the Netherlands Energy Research Foundation designed Wet Annular Denuder that is used for the determination of ammonia, nitric acid and sulfur dioxide. We are now actively considering whether to borrow and or purchase an instrument for use in our field campaigns. If done it will be the first such instrument deployed in the US Highlights from the 4 German institutes visited include information on: sophisticated deployment of OH measuring capabilities involving lasers including laser induced fluorescence, long path UV, and differential optical absorption; tunable diode lasers utilized to measure a variety of substances; field investigations directed at elucidating cloud processes and reactions in ground based fogs; extensive use of spectroscopy to measure elemental and gaseous pollutants.

24569 (BNL–70309) **[The North Atlantic Regional Experiment (NARE)]: Foreign trip report, January 25, 1993–January 30, 1993.** Daum, P. Brookhaven National Lab., Upton, NY (United States). 22 Mar 1993. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. Order Number DE93010126. Source: OSTI; NTIS (US Sales Only); GPO Dep.

A planning meeting for the North Atlantic Regional Experiment (NARE) summer 1993 field intensive was attended. The meeting was held at the University of East Anglia, Norwich, England from January 26–29, 1993. The meeting was organized by Stuart Penkett, and was attended by scientists from both North America and Europe. The summer intensive will be conducted during the month of August. Participating North American scientists will focus efforts on measurements along the northeastern coast of the US and in Nova Scotia. They will also support surface measurements in the Azores, Iceland, and in Bermuda. At least three instrumented aircraft will contribute to the North American effort. European activities will focus on the British Meteorological Office C-130 aircraft. The Europeans will also activate a number of existing sites to measure ozone concentration profiles. The coordination between measurements conducted on either side of the Atlantic will not be close because of the lack of meteorological data in the mid-Atlantic which would allow prediction of transoceanic transport.

24570 (CFS/OO–46-13/35-1991E, pp. 17-20) **The acid rain phenomenon.** Martin, H.C. (Atmospheric Environment Service, Environment Canada, Downsview, ON (Canada)). Canadian Forestry Service, Ottawa, ON (Canada). 1991. (CONF-8306311–: Effects of acid rain on forest resources, Sainte-Foy (Canada), 14-17 Jun 1983; MICROLOG–92-03656). In *Effects of acid rain on forest resources: Proceedings*. 667p. Source: PC Forestry Canada, Place Vincent Massey, 351 St. Joseph Blvd., Ottawa, ON, CAN K1A 1G5; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1 PC PRICES UPON REQUEST; MF $10 CAN.

An overview is presented of the acid rain phenomenon, following the pollutants from their sources, through the atmosphere, to deposition and environmental responses. In the northern hemisphere, acidification is co-located with highly industrialized regions. Sulfur dioxide emitted into the atmosphere is deposited unoxidized in a dry form or is oxidized. It may react with water before or after oxidation to be deposited as a sulfate. Nitrogen oxides are similarly oxidized, however the process is complicated by photochemical effects. To measure surface deposition a network system is required. There are no long-standing networks for measuring dry deposition. Despite difficulty is assessing sensitivity, it is evident that regions at risk include upper New England and the eastern central portions of Ontario, Quebec and the Maritimes. The complexities of acid rain modelling are discussed. Aquatic responses to acidification include fish extinction, sphagnum moss invasion, and overall reduced diversity and populations of organisms.

24571 (CONF-920435–1) **Scale aggregation in semi-smooth flow.** Max-Planck-Institut fuer Meteorologie. Report. Claussen, M. Max-Planck-Institut fuer Meteorologie, Hamburg (Germany). Aug 1992. 23p. From 17. general assembly of the European Geophysical Society; Edinburgh (United Kingdom); 6-10 Apr 1992. Order Number DE93795283. Source: OSTI; NTIS (US Sales Only).

Recent work on vertical momentum, heat, and moisture transport over heterogeneous terrain has indicated that small areas of large roughness or obstacles dominate the regional momentum flux, whereas the regional heat and moisture fluxes are determined by the dominant surface cover. Therefore, it is hypothesized that regional momentum flux should be evaluated from an effective roughness length which implicitly accounts for the form drag of obstacles, whereas regional heat and moisture fluxes should be estimated from local surface parameters such as local roughness lengths. This hypothesis compares favorably with other proposals when testing it by using numerical simulations of regional surface fluxes in boudary-layer flow over homogeneous terrain with sparsely distributed roughness elements, i.e. in so-called semi-smooth flow. (orig.).

24572 (CONF-920791–, pp. 7, Paper 17) **Continuous emission monitor for incinerators.** Demirgian, J. (Argonne National Lab., IL (US)). USDOE Assistant Secretary for Environmental Restoration and Waste Management, Washington, DC (United States). Jul 1992. From Information exchange meeting on characterization sensors and monitoring technologies; Dallas, TX (United States); 15-16 Jul 1992. In *Proceedings of the information exchange meeting on characterization, sensors, and monitoring*

technologies. 261p. Order Number DE93005318. Source: OSTI; NTIS.

This paper describes the development of Fourier transform infrared (FTIR) spectroscopy to continuous monitoring of incinerator emissions. Fourier transform infrared spectroscopy is well suited to this application because it can identify and quantify selected target analytes in a complex mixture without first separating the components in the mixture. Currently, there is no on-stream method to determine the destruction of hazardous substances, such as benzene, or to continuously monitor for hazardous products of incomplete combustion (PICS) in incinerator exhaust emissions. This capability is especially important because of Federal regulations in the Clean Air Act of 1990, which requires the monitoring of air toxics (Title III), the Resource Conservation and Recovery Act (RCRA), and the Toxic Substances Control Act (TSCA). An on-stream continuous emission monitor (CEM) that can differentiate species in the ppm and ppb range and can calculate the destruction and removal efficiency (DRE) could be used to determine the safety and reliability of incinerators. This information can be used to address reasonable public concern about incinerator safety and aid in the permitting process.

24573 (CONF-920791–, pp. 6, Paper 31) **Characterization sites field analytical methods.** Guerin, M.R. (Oak Ridge National Lab., TN (US)); Wise, M.B. USDOE Assistant Secretary for Environmental Restoration and Waste Management, Washington, DC (United States). Jul 1992. From Information exchange meeting on characterization sensors and monitoring technologies; Dallas, TX (United States); 15-16 Jul 1992. In *Proceedings of the information exchange meeting on characterization, sensors, and monitoring technologies.* 261p. Order Number DE93005318. Source: OSTI; NTIS.

Direct Sampling Ion Trap Mass Spectrometry (DSITMS) has been under development in our laboratory for several years for the rapid determination of organics in environmental samples. This technology involves the introduction of samples directly into the mass spectrometer without sample preparation or compound separation and has been shown to have great promise for sample screening and target compound analysis. Both laboratory and field-based instruments have been developed and are being evaluated. These instruments are equipped with a specially designed direct sampling system and a set of quick connecting sampling modules for the analysis of air, water, and soil which allow the instrument to be converted from one sampling configuration to another without breaking vacuum to the ion trap. Tests of the laboratory and field DSITMS instruments have been highly successful and have demonstrated the ability to quickly and easily perform measurements of volatile organic compounds (VOCS) such as benzene, chlorinated solvents, and gasoline and in a wide range of environmental samples. Analysis times range from real time for direct air monitoring applications to approximately 3 minutes for the quantitative determination of VOCs in water and soil samples. Detection limits for VOCs in water are typically in the range of 1 to 5 ppb and in air range from 1 to 100 ppb by volume (ppbv).

24574 (CONF-9209353–1) **Biomes computed from simulated climatologies.** Max-Planck-Institut fuer Meteorologie. Report. Claussen, W.; Esch, M. Max-Planck-Institut fuer Meteorologie, Hamburg (Germany). Sep 1992. 21p. From 2. international conference on modelling of global climate change and variability; Hamburg (Germany); 7-11 Sep 1992. Order Number DE93792714. Source: OSTI; NTIS (US Sales Only).

The biome model of Prentice et al. is used to predict global patterns of potential natural plant formations, or biomes, from climatologies simulated by ECHAM, a model used for climate simulations at the Max-Planck-Institut fuer Meteorologie. This study is undertaken in order to show the advantage of this biome model in comprehensively diagnosing the performance of a climate model and assessing effects of past and future climate changes predicted by a climate model. Good overall agreement is found between global patterns of biomes computed from observed and simulated data of present climate. But there are also major discrepancies indicated by a difference in biomes in Australia, in the Kalahari Desert, and in the Middle West of North America. These discrepancies can be traced back to failures in simulated rain fall as well as summer or winter temperatures. Global patterns of biomes computed from an ice age simulation reveal that North America, Europe, and Siberia should have been covered largely by tundra and taiga, whereas only small differences are seen for the tropical rain forests. A potential North-East shift of biomes is expected from a simulation with enhanced CO_2 concentration according to the IPCC Scenario A. Little change is seen in the tropical rain forest and the Sahara. Since the biome model used is not capable of predicting changes in vegetation patterns due to a rapid climate change, the latter simulation has to be taken as a prediction of changes in conditions favorable for the existence of certain biomes, not as a prediction of a future distribution of biomes. (orig.).

24575 (CONF-921276–, pp. 227-230) **New catalyst for CO2 reduction.** Osaki, T. (Government Industrial Research Institute, Nagoya, Nagoya (Japan)); Taoda, H.; Yamakita, H. 3 Dec 1992. 305p. (In Japanese). From 1992 Japan Solar Energy Society, Japan Wind Energy Association joint converence; Osaka (Japan); 3-4 Dec 1992. In *1992 JSES (Japan Solar Energy Society)/JWEA (Japan Wind Energy Association) Joint Conference.* Order Number DE93793955. Source: OSTI; NTIS (US Sales Only).

Discussions were given on contact hydrogenation of CO2 using newly prepared catalysts to cope with the CO2 emission problem and regenerate CO2 into usable resources. Hydrogen and argon gas mixture was passed through (NH4)2WS4 at 400°C to prepare a WS2 catalyst (catalyst No. 1). Similarly, an MoS2 catalyst (catalyst No. 4) was made from (NH4)2MoS4. A contact hydrogenation reaction of CO2 at 450°C for 50 hours produced only CO as a reduction product with a selection factor of 99.9% or higher. The conversion factor from CO2 to CO was about 25% for the catalyst No. 1, and about 15% for the catalyst No. 4, which are higher than in catalysts of identical composition that are available commercially. The activation energy (kJ/mol) showed lower values from 24.7 to 20.5 than commercially available products at from 66.5 to 72.8. The catalysts No. 1 and 4 have larger surface area and lower crystallinity than those in catalysts available on the market. Chemical analysis of the subject catalysts detected a large quantity of oxygen (oxygen from CO2), which suggests that there are a large number of activation points for reduction. 3 refs., 7 figs., 3 tabs.

24576 (CONF-930701–2) **Guidance on management of nonresidential indoor air quality.** Gammage, R.B. (Oak Ridge National Lab., TN (United States)); Sowinski, E.J.; Tiffany, J. Oak Ridge National Lab., TN (United States). [1993]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 6. international conference on indoor air quality and climate; Helsinki (Finland); 4-8 Jul 1993. Order Number DE93010278. Source: OSTI; NTIS; INIS; GPO Dep.

An interdisciplinary approach is needed for the effective recognition, evaluation, and control of indoor air quality (IAQ), which also requires a performance oriented management plan. Industrial hygienists are uniquely suited to play a central role, along with HVAC mechanical and building engineers and architects. IAQ problems are typically associated with inadequate performance of heating, ventilation, and air conditioning (HVAC) systems. Typical environmental measuring techniques, and the use of threshold limit values (TLVs), are usually not relevant to IAQ investigations. Research priorities aimed at multiple chemical sensitivity, standardization of air sampling procedures, and demonstration of technology in model buildings are presented.

24577 (DOE/ER–0586T) **Program Operations Plan: Atmospheric Chemistry Program.** USDOE Office of Energy Research, Washington, DC (United States). Office of Health and Environmental Research. Apr 1993. 105p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93012765. Source: OSTI; NTIS; GPO Dep.

The Department of Energy's Atmospheric Chemistry Program (ACP) was initiated in 1991 to coordinate DOE's university and federal-laboratory atmospheric-chemistry research, and to focus these efforts on national and international information requirements in the atmospheric-chemistry field. This Program Operations Plan describes the structure and vision of the effort designed to fulfill these needs, and is divided into two major components. The first of these is a Strategic Plan, which outlines the ACP's rationale, objectives, and vision, and describes its products that are anticipated

over a future ten-year period. Although based on realistic appraisals of goals that are attainable given the financial, material, and intellectual resources of the ACP community, this Strategic Plan does not describe these resources themselves. The second component of the Program Operations Plan, the Implementation Plan, deals directly with these resource considerations. As such it focuses on practical implementation of Strategic-Plan elements at the individual research institutions, the anticipated scientific contributions of these groups, and their coordination within the ACP. In contrast to the Strategic Plan, this Implementation Plan extends only five years into the future.

24578 (DOE/ER–0588) **Radon Research Program, FY 1992.** USDOE Office of Energy Research, Washington, DC (United States). Office of Health and Environmental Research; Oak Ridge Inst. for Science and Education, TN (United States). Apr 1993. 251p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-76OR00033. Order Number DE93013736. Source: OSTI; NTIS; INIS; GPO Dep.

The United States Department of Energy, Office of Health and Environmental Research (DOE/OHER) is the principal federal agency conducting basic research related to indoor radon. The scientific information being sought in this program encompasses research designed to determine radon availability and transport outdoors, modeling transport into and within buildings, physics and chemistry of radon and radon progeny, dose response relationships, lung cancer risk, and mechanisms of radon carcinogenesis. There still remains a significant number of uncertainties in the currently available knowledge that is used to estimate lung cancer risk from exposure to environmental levels of radon and its progeny. The main goal of the DOE/OHER Radon Research Program is to develop information to reduce these uncertainties and thereby provide an improved health risk estimate of exposure to radon and its progeny and to identify and understand biological mechanisms of lung cancer development and required copollutants at low levels of exposure. Information useful in radon control strategies is also provided by the basic science undertaken in this program.

24579 (DOE/ER/60372–8) **Recent changes of weather patterns in North America: Progress report, August 15, 1992–April 1, 1993.** Kukla, G.J. (Columbia Univ., Palisades, NY (United States). Lamont-Doherty Geological Observatory); Karl, T. Columbia Univ., Palisades, NY (United States). Lamont-Doherty Geological Observatory; National Climatic Data Center, Asheville, NC (United States). Apr 1993. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-85ER60372. Order Number DE93013982. Source: OSTI; NTIS; INIS; GPO Dep.

Climate models predict a general increase of surface air temperature and drought frequency in parts of the North American continent due to increased CO_2 concentrations. Regional climate change results in part from the changed frequency of the atmospheric and oceanic circulation patterns in addition to the changed properties of the different air mass types. We are investigating the frequency and properties of the air mass types differentiated by moisture dependent variables and comparing the findings to that simulated by numerical climate models. The objectives of this project are to analyse the time related changes and variability in the properties and frequency of air masses and weather extremes over North America. To determine the agree to which the observed changes agree with climate model predictions.

24580 (DOE/ER/61417–1) **[Tools for determining health of phytoplankton cells].** Oregon Univ., Eugene, OR (United States). Dept. of Biology. [1992]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG06-92ER61417. Order Number DE93015060. Source: OSTI; NTIS; GPO Dep.

The primary purpose of the proposed research is to develop molecular tools for determining the health of marine phytoplankton on an individual cell basis. Since the definition of healthy in phytoplankton cells is elusive, we propose to develop markers for several different metabolic processes indicative of physiological state: photosynthetic activity, esterase activity, membrane permeability, and mitochondrial activity. One underlying motivation is to develop methods which will allow us to evaluate the hypothesis that, while healthy cells release very little dissolved organic carbon (DOC), many phytoplankton communities are comprised of unhealthy or physiologically stressed cells which release a large proportion of total photosynthate directly into the pool of labile DOC. This is proposed to be especially true in continental shelf and coastal environments where zones of productivity are patchy and phytoplankton populations adapted to one regime can be easily transported into waters which differ in salinity, nutrient supply, and/or turbidity. The significance of the work, however, extends beyond this immediate goal since there are presently relatively few methods which allow us to estimate the physiological state of phytoplankton cells.When we evaluate population sizes of phytoplankton in the water column or examine fecal pellets, particulate aggregates, or other material, we generally work in ignorance of the activity of the cells except as the average cell-specific activity is estimated from bulk measurements. This approach effectively hides any differences in the relative contribution of different taxa or individuals to overall productivity eventhough most flux processes are sensitive to physiological and taxonomically determined differences among members of the community.

24581 (DOE/MC/29116–3355) **Novel mass spectrometric instrument for gaseous and particulate characterization and monitoring: Technical progress report, September 25, 1992–December 31, 1992.** Coggiola, M.J. SRI International, Menlo Park, CA (United States). Feb 1993. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC21-92MC29116. Order Number DE93014093. Source: OSTI; NTIS; GPO Dep.

SRI International will develop a unique new instrument that will be capable of providing real-time, quantitative, chemical characterization of gaseous and particulate pollutants generated from DOE waste cleanup activities. The instrument will be capable of detecting and identifying volatile organic compounds, polynuclear aromatic hydrocarbons, heavy metals, and transuranic species released during waste cleanup activities. The instrument will be unique in its ability to detect and quantify in real-time these diverse pollutants in both vapor and particulate form. The function of the sampler is to obtain a sufficient and representative quantity of air pollutants from a wide range of waste cleanup activities, both vapor and particulate. In addition, the sampler must deliver the vapors and particles to the detection instrument with minimal material loss.

24582 (EGG–10617-1227) **An aerial radiological survey of Par Pond and associated drainage pathways of the Savannah River Site, Aiken, South Carolina: Date of survey: August 19–November 11, 1991.** EG and G Energy Measurements, Inc., Las Vegas, NV (United States). Remote Sensing Lab. Dec 1992. 32p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC08-88NV10617. Order Number DE93008084. Source: OSTI; NTIS; INIS; GPO Dep.

The first of a three-phase effort to radiologically monitor the lowering of Par Pond and associated drainage pathways was conducted over three areas of the Savannah River Site (SRS). The areas surveyed during this first phase included Par Pond, the Savannah River swamp from Steel Creek to Little Hell Landing, and Lower Three Runs Creek from the mouth of Lower Three Runs to the Highway 301 Bridge. The first phase was conducted to coincide with the lowering of the water level of Par Pond to an elevation of 190 feet above sea level. Additional surveys were conducted when the water level was at an elevation of 180 feet and prior to refill. The first survey began August 19, 1991, and was completed September 11, 1991. The second survey was conducted in October/November, 1991, during the SRS site-wide survey, and the third survey was conducted in August/September, 1992. Only the Par Pond area itself was surveyed during the third and final phase. The radiation detected over the Creek Plantation portion of the Savannah River swamp and Lower Three Runs areas during the August 1991 survey was consistent with the spatial distribution, quantity, and kinds of radionuclides detected during the 1983 and 1986 surveys. No migration of man-made gamma emitting materials was detected when compared to the prior surveys. The major differences occurred along the Par Pond shoreline where lowered water levels exposed the contaminated pond bed. The activity in the pond bed was attenuated by the water cover prior to the start of the lowering of Par Pond in June 1991. The data collected during each survey were processed in the field and

were presented to SRS. A comparison report is being generated after the completion of each survey. A final report will be generated for the three surveys and will include a quantitative comparison of the three surveys in the Par Pond area only.

24583 (EML–549) **Project AIRSTREAM: Trace gas final report.** Leifer, R. Department of Energy, New York, NY (United States). Environmental Measurements Lab. Dec 1992. 164p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93008849. Source: OSTI; NTIS; INIS; GPO Dep.

The results of 10 years of sampling for trace gases in the upper troposphere and lower stratosphere are presented. These samples were collected under the auspices of the Atomic Energy Commission (AEC), the Energy Research and Development Administration (ERDA) and the Department of Energy (DOE). Almost 1000 whole air samples were collected during the years 1973 to 1983 under Project AIRSTREAM. Project AIRSTREAM was part of the Environmental Measurements Laboratory's (EML, at that time called the Health and Safety Laboratory/HASL) research effort to investigate the impact of the injection of radionuclides and stable compounds into the stratosphere. One or more of the following compounds were analyzed: CCl_3F, CCl_2F_2, CCl_4, N_2O, SF_6, CO_2, CH_4, CH_3CCl_3, and COS. Details of the Project's quality assurance program are discussed. Also included in the report are two-dimensional plots of the concentration of CCl_3F and a complete tabulation of the data.

24584 (ES/ER/TM–62) **Aerial remote sensing surveys progress report: Helicopter geophysical survey of the Oak Ridge Reservation.** Doll, W.E. (Oak Ridge National Lab., TN (United States)); Nyquist, J.E.; King, A.D.; Bell, D.T.; Holladay, J.S.; Labson, V.F.; Pellerin, L. Oak Ridge National Lab., TN (United States). Mar 1993. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93011828. Source: OSTI; NTIS; INIS; GPO Dep.

The 35,252 acre Department of Energy Oak Ridge Reservation (ORR) in the western portion of the Appalachian Valley and Ridge Province in Tennessee, has been a nuclear production and development facility for50 years. Contaminants in the many waste sites on the ORR include a wide variety of radioactive isotopes as well as many organic and inorganic compounds. The locations, geometry, and contents of many of these waste sites are reasonably well known, while others are poorly known or unknown. To better characterize the reasonably well known sites and search for additional potentially environmentally hazardous sites, a two-phase aerial survey of the ORR was developed. Phase I began in March 1992 and consisted of aerial radiation, multispectral scanner, and photographic (natural color and color infrared) surveys. Phase II began in November 1992 and is described in this report. Phase II consisted of helicopter electromagnetic (HEM), magnetic, and gamma radiation surveys. Targets of the survey included both man-made (drums, trench boundaries, burn pits, well heads) and geologic (fractures, faults, karst features, geologic contacts) features. The Phase II survey has three components: testing, reconnaissance, and high-resolution data acquisition. To date, the testing and reconnaissance data acquisition have been completed, and some of the data have been processed. They indicate that: (1) magnetic and HEM data are complementary and do not always highlight the same anomaly; (2) under favorable circumstances, helicopter magnetometer systems are capable of detecting groups of four or more 55-gal drums at detector altitudes of 15 m or less; (3) HEM data provide data that compare favorably with surface data collected over burial trenches, (4) well casings may be related to magnetic monopole anomalies, as would be expected; and (5) changes in HEM and magnetic anomaly character are related to lithologic changes and may be used to track contacts between known outcrops.

24585 (ETDE-mf–93792551) **Remote sensing of cloud base temperature of convective clouds over the ocean.** Berichte aus dem Zentrum fuer Meeres- und Klimaforschung der Universitaet Hamburg. Manschke, A. Hamburg Univ. (Germany). Zentrum fuer Meeres- und Klimaforschung; Hamburg Univ. (Germany). Fachbereich 15 - Geowissenschaften. 1991. 114p. (In German). Order Number DE93792551. Source: OSTI; NTIS (US Sales Only).

The possibility to derive the cloud base temperature by remote sensing for convective cloudfields over oceans with the spaceborne infrared radiometer AVHRR is investigated. First, a set of atmospheric data for polar cold air outbreaks is prescribed, containing different cloud base temperature, cloud droplet size distributions, and other parameters influencing the radiative transfer properties. Top of the atmosphere radiances are then calculated with the help of a one-dimensional adding and doubling model of radiative transfer in order to simulate the expected signals in the thermal infrared channels of the AVHRR. Finally, the effect of cloud base temperature on the radiation budget of the ocean surface is estimated. Results of radiative transfer calculations show an increase of longwave downward flux densities by up to 90 W/m^2 for the cloud covered sky as compared to cloudless conditions. This considerable increase is due to the low water vapour amount in polar boundary layers. The sensitivity of the longwave net flux density to cloud base temperature is about 2 W/m^2 per Kelvin. (orig.).

24586 (ETDE-mf–93792573) **Development and practical use of a mobile lidar system to measure the ozone concentration in the troposphere up to 13 km high by means of differential absorption. Final report.** Carnuth, W.; Trickl, T. Fraunhofer-Institut fuer Atmosphaerische Umweltforschung (IFU), Garmisch-Partenkirchen (Germany); Bundesministerium fuer Forschung und Technologie, Bonn (Germany). 1 Feb 1992. 32p. (In German). Contract BMFT 07EU7104. Order Number DE93792573. Source: OSTI; NTIS (US Sales Only).

In the context of this project, a UV lidar system was developed to measure the change with time of the vertical ozone distribution in the troposphere between about 0.1 km and 12 km above the site of the lidar (740 m above 0D). This very large range of measurement with regard to the back scatter signal reduced by more than six orders of magnitude in the troposphere is achieved by the use of a powerful KrF laser, two separate receiving telescopes and various electronic circuits. The accuracy of measurement estimated in the description of project (5 to 15 ppbv depending on height) was proved. It was found that considerable improvements are even possible. In 1991, a first complete year's series of ozone soundings of over 500 individual measurements was carried out. It was found that the lidar equipment represents a valuable supplement to the mountain stations operated by the IFU. (orig.) With 6 refs., 12 figs.

24587 (ETDE-mf–93795279) **Investigations into the chemistry of atmospheric peroxides. Final report. Pt. A and B.** Forschungsberichte zum Forschungsprogramm des Landes Nordrhein-Westfalen 'Luftverunreinigungen und Waldschaeden'. Becker, K.H. (Wuppertal Univ. (Gesamthochschule) (Germany). Lehrgebiet Physikalische Chemie); Brockmann, K.J.; Bechara, J.; Klockow, D.; Cramer, C.; Esser, G.; Hoffmann, T.; Jacob, P.; Troost, G.; Valdes, J. Wuppertal Univ. (Gesamthochschule) (Germany). Lehrgebiet Physiaklische Chemie; Institut fuer Spektrochemie und Angewandte Spektroskopie (ISAS), Dortmund (Germany); Ministerium fuer Umwelt, Raumordnung und Landwirtschaft des Landes Nordrhein-Westfalen, Duesseldorf (Germany). Jun 1992. 161p. (In German). Order Number DE93795279. Source: OSTI; NTIS (US Sales Only).

This project investigates the atmospheric-chemical behaviour of hydroperoxides as a part of the atmospheric oxidants blamed for contributing to novel forest decline. In particular, the investigations covered such processes as form hydrogen peroxide in the gas or liquid phase or on icy surfaces, by the effect of light or by reactions of ozone with biogenous alkenes. A diode laser spectroscope was used in combination with a long-path infra-red absorption cell and a temperature-adjustable photoreactor for studying the reactions of ozone with different terpenes and some non-biogenic alkenes, under atmospheric conditions, regarding H_2O_2 formation. The reaction with water vapour of the intermediate products from the ozone/terpene reactions represents a hitherto unknown source of H_2O_2 in forest air. This formation of H_2O_2 acquires importance particularly where high levels of atmospheric NO (> 10 pptV) and ozone occur at a close distance to intense sources of biogenic alkenes. (orig./EF).

24588 (ETDE-mf–93795282) **Optimal fingerprints for the detection of time dependent climate change.** Max-Planck-Institut fuer Meteorologie. Report. Hasselmann, K. Max-Planck-Institut fuer

Meteorologie, Hamburg (Germany). Aug 1992. 43p. Order Number DE93795282. Source: OSTI; NTIS (US Sales Only).

An optimal linear filter (fingerprint) is derived for the detection of a given time-dependent, multi-variate climate-change signal in the presence of natural climate variability noise. Application of the fingerprint to the observed (or model-simulated) climate data yields a climate-change detection variable (detector) with maximal signal-to-noise ratio. The optimal fingerprint is given by the product of the assumed signal pattern and the inverse of the climate variability covariance matrix. The data can consist of any, not necessarily dynamically complete climate data set for which estimates of the natural variability covariance matrix exist. The single-pattern analysis readily generalizes to the multi-pattern case of a climate-change signal lying in a prescribed (in practice relatively low-dimensional) signal-pattern space: the single-pattern result is simply applied separately to each individual base pattern spanning the signal pattern space. Multi-pattern detection methods can be applied either to test the statistical significance of individual components of a predicted multi-component climate change response, using separate single-pattern detection tests, or to determine the statistical significance of the complete signal, using a multi-variate test. (orig.).

24589 (ETDE-mf–93795284) **Simulation of the present-day climate with the ECHAM model: Impact of model physics and resolution.** Max-Planck-Institut fuer Meteorologie. Report. Roeckner, E. (Max-Planck-Institut fuer Meteorologie, Hamburg (Germany)); Arpe, K.; Bengtsson, L.; Duemenil, L.; Esch, M.; Brinkop, S.; Ponater, M.; Sausen, R.; Kirk, E.; Lunkeit, F.; Schubert, S.; Windelband, M.; Rockel, B. Max-Planck-Institut fuer Meteorologie, Hamburg (Germany). Oct 1992. 175p. Order Number DE93795284. Source: OSTI; NTIS (US Sales Only).

A detailed description of the third-generation atmospheric general circulation model ECHAM is presented. The climatology of ECHAM3, as simulated at low and high resolution (T21 and T42, respectively), is compared with ECMWF analyses (1981-1990) and also with the climatology of two earlier low resolution versions ECHAM1 and ECHAM2. At low resolution, the impact of the improved model physics is evident primarily in the simulated time-mean state which is more successfully reproduced by the more recent model versions, particularly by ECHAM3. The impact of increased horizontal resolution can be identified not only by a generally improved time-mean circulation, particularly in the Southern Hemisphere, but most-significantly by the increased level of high-frequency variability. In the low-frequency range, however, the impact of increased horizontal resolution is modest, and all models fail to reproduce the observed level of low-frequency intraseasonal variability. (orig.).

24590 (ETDE-mf–93795285) **Signal-to-noise analysis of time-dependent greenhouse warming experiments. Pt. 1. Pattern analysis.** Max-Planck-Institut fuer Meteorologie. Report. Santer, B.D. (Lawrence Livermore Lab., CA (United States). Program for Climate Model Diagnosis and Intercomparison); Brueggemann, W.; Cubasch, U.; Hasselmann, K.; Hoeck, H.; Maier-Reimer, E.; Mikolajewicz, U. Max-Planck-Institut fuer Meteorologie, Hamburg (Germany). Jan 1993. 54p. Order Number DE93795285. Source: OSTI; NTIS (US Sales Only).

Results from a control integration and time-dependent greenhouse warming experiments performed with a coupled ocean-atmosphere model are analysed in terms of their signal-to-noise properties. The aim is to illustrate techniques for efficient description of the space-time evolution of signals and noise and to identify potentially useful components of a multivariate greenhouse-gas 'fingerprint'. The three 100-year experiments analysed here simulate the response of the climate system to a step-function doubling of CO_2 and to the time-dependent greenhouse-gas increases specified in Scenarios A ('Business as Usual') and D ('Draconian Measures') of the Intergovernmental Panel on Climate Change (IPCC). (orig.).

24591 (ETDE-mf–93795286) **Air pollution by polycyclic aromatic hydrocarbons (PAH) in the city of Hamburg.** Hamburger Umweltberichte. Kersten, W.; Reich, T. Umweltbehoerde, Hamburg (Germany). 1992. 110p. (In German). Order Number DE93795286. Source: OSTI; NTIS (US Sales Only).

Polycyclic aromatic hydrocarbons (PAH) and their leader components benzo(a)pyrenes (BaP) are considered critical air pollutants on account of their carcinogenic action. PAH/BaP air pollution in the city of Hamburg was assessed in the course of a twelve-months' test program in 1989/90. Mean annual values were determined for 22 PAH constituents in eight selected areas of different air qualities. Twenty samples were taken in each measuring place. In addition to the usual analyses of PAH bound in airborne particles 60 out of 160 samples were analyzed for constituents which pass the filter. Air pollution by PAH bound in airborne particles and by PAH which pass the filter was put at 15 ng/m^3 or 24 ng/m^3, respectively for the sum of the 22 PAH constituents. A concentration of about 0.9 ng/m^3 was found for benzo(a)pyrenes. Higher values were measured in places located in the vicinity of frequented roads or residential buildings with coal-fired space heating systems. The city of Hamburg was found to be ranking with the less polluted crowded areas. (orig./BBR).

24592 (ETDE-mf–93796945) **Economic Commission for Europe NO_x Task Force 'Operating experience with NO_x abatement at stationary sources'.** Rentz, O.; Ribeiro, J. Karlsruhe Univ. (T.H.) (Germany). Inst. fuer Industriebetriebslehre und Industrielle Produktion. Dec 1992. 325p. Order Number DE93796945. Source: OSTI; NTIS (US Sales Only).

The report gives an overview of the operational experience of NO_x abatement technologies at stationary sources and the implementation status of these technologies in the various emission sectors. Besides this, NO_x emission data of some ECE countries are listed and a compilation of the regulative measures for NO_x emissions control of several ECE countries is given. The report is based on information submitted by Task Force members and from data published elsewhere, as well as from plant operators. (orig.).

24593 (FEMP–2270) **Statistical analysis of real-time, environmental radon measurement results at the Fernald Environmental Management Project.** Liu, Ning (Univ. of Cincinnati, OH (United States). Dept. of Mechanical, Industrial, and Nuclear Engineering); Spitz, H.; Dai, L.; Tomczak, L. Westinghouse Environmental Management Co. of Ohio, Cincinnati, OH (United States). Fernald Environmental Management Project. Sep 1992. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-86OR21600. (CONF-930130–15: 26. Health Physics Society midyear topical meeting on environmental health physics; 38. annual conference on bioassay, analytical and environmental radiochemistry, Coeur d'Alene, ID (United States); Santa Fe, NM (United States), 24-28 Ja Order Number DE93012894. Source: OSTI; NTIS; INIS; GPO Dep.

A comprehensive real-time, environmental radon monitoring program is being conducted at the Fernald Environmental Management Project (FEMP) where approximately 8,800 metric tons of uranium residues produced during operation of the plant have been stored in underground, covered silos since the 1950's. Statistical analyses of the radon measurements were undertaken to investigate what impact, if any, radon emitted by the radium bearing materials contained in the silos makes to the natural background radon concentration. For evaluation purposes, the site was divided into four general areas; (1) the site boundary or perimeter, (2) the production/administration areas, (3) the waste storage areas (silos), and (4) offsite background located approximately 13 km away from FEMP. Results from monitors located in each of the four areas were analyzed independently and as group by area to investigate the temporal and spatial variations in the measurements. A series of contrast tests applied to the radon measurement results obtained from February 1991 and 1992 demonstrate that, at any nine, the radon concentration is statistically equal (at the 95% confidence level) in all areas of the FEMP except for the silo area. That is, differences in the measured radon concentration in and around the FEMP during 1991 and 1992 were not detectable at any area unless you were very close to the silos. In November, 1991, a new sealant barrier was applied to the silos which appears to have significantly reduced the radon concentration near the source but made no detectable reduction elsewhere.

24594 (GKSS–92/E/51) **Numerical modeling of the transport and chemical transformation of mercury over Europe.** Petersen, G. (GKSS-Forschungszentrum Geesthacht GmbH,

Geesthacht-Tesperhude (Germany). Inst. fuer Physik). GKSS-Forschungszentrum Geesthacht GmbH, Geesthacht-Tesperhude (Germany); Hamburg Univ. (Germany). Fachbereich 15 - Geowissenschaften. 1992. 153p. (In German). Order Number DE93792029. Source: OSTI; NTIS (US Sales Only).

Numerical models based on the transport and diffusion module of the EMEP model have been developed to investigate the long-range transport, the chemical transformation and the atmospheric deposition of mercury. A number of physical and chemical processes of atmospheric mercury recently investigated in Sweden have been implemented into the model. Model runs were focussed on estimates of atmospheric mercury input into the North Sea and the Baltic Sea and on scenario runs on divalent inorganic mercury compounds and on the role of soot particles for the atmospheric mercury load. Since the model has been successfully verified with Scandinavian land-based measurements, the calculated range of 5-12 tonnes mercury per year for the North Sea and 6-13 tonnes per year for the Baltic are considered to be the most reliable data currently available. (orig.) With70 figs., 20 tabs.

24595 (LA-UR–93-857) **Regional climatology sensitivity studies.** Bossert, J.E. (Los Alamos National Lab., NM (United States)); Kao, C.Y.J.; Winterkamp, J.L.; Roads, J.O.; Chen, Shyh-C. Los Alamos National Lab., NM (United States). Feb 1993. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9303122–1: 3. ARM science team meeting, Norman, OK (United States), 1-5 Mar 1993). Order Number DE93010712. Source: OSTI; NTIS; GPO Dep.

Recent interest in understanding climate and climate change at regional-scales has led to the application of mesoscale models for regional climatology studies. These models can provide an understanding of climate processes in a physically consistent way at much higher resolution than presently offered by GCMs. In recent work, we have tried to address questions in the RAMS mesoscale model to establish confidence in our modeling procedure. A more rigorous comparison of our modeling results with various data sets is reported in Roads et al. (1992). In the present paper, we use two simple numerical experiments to examine the impact of grid configuration on the predicted precipitation field from the RAMS model. We intend to demonstrate that the choice of the lateral boundaries and grid configurations can significantly impact the predicted fields of interest.

24596 (NEI-DK–1102) **Objectives for next generation of practical short-range atmospheric dispersion models: Proceedings of the workshop.** Olesen, H.R.; Mikkelsen, T. (eds.). Dansk Center for Atmosfaereforskning (DCAR), Roskilde (Denmark). 1992. [271p.] (CONF-9205345–: Workshop on objectives for next generation of practical short-range atmospheric dispersion models, Roskilde (Denmark), 6-8 May 1992). Order Number DE93625642. Source: OSTI; NTIS; INIS.

The proceedings contains papers from the workshop "Objectives for Next Generation of Practical Short-Range Atmospheric Dispersion Models". They deal with two types of models, namely models for regulatory purposes and models for real-time applications. The workshop was the result of an action started in 1991 for increased cooperation and harmonization within atmospheric dispersion modelling. The focus of the workshop was on the management of model development and the definition of model objectives, rather than on detailed model contents. It was the intention to identify actions that can be taken in order to improve the development and use of atmospheric dispersion models. The papers in the proceedings deal with various topics within the broad spectrum of matters related to up-to-date practical models, such as their scientific basis, requirements for model input and output, meteorological preprocessing, standardisation within modelling, electronic information exchange as a potentially useful tool, model evaluation and data bases for model evaluation. In addition to the papers, the proceedings contain summaries of the discussions at the workshop. These summaries point to a number of recommended actions which can be taken in order to improve "modelling culture". (AB).

24597 (NEI-DK–1102, pp. 41-48) **Standardization in the field of air quality: Activities of ISO and CEN.** Grefen, K. (Kommission Reinhaltung der Luft im VDI und DIN (Germany)); Weber, K. Dansk Center for Atmosfaereforskning (DCAR), Roskilde (Denmark). 1992. (CONF-9205345–: Workshop on objectives for next generation of practical short-range atmospheric dispersion models, Roskilde (Denmark), 6-8 May 1992). In *Objectives for next generation of practical short-range atmospheric dispersion models: Proceedings of the workshop.* [271p.] Order Number DE93625642. Source: OSTI; NTIS; INIS.

The importance of guidelines and standards related to air pollution abatement technology is explained, also in relation to the European Single Market. The responsibilities of the joint committee of "Verein Deutscher Ingenieure" and "Deutsches Institut fuer Normung" in producing guidelines for air quality protection in Germany, and their organization and scope are clarified. The CEN (Comite Europeen de Normalisation) is also dealt with and some of its activities are described. The activities and scope of the International Organization for Standardization (ISO) are elucidated. The author concludes that all European national institutions for standardization should take a more active part in standard setting procedures, via CEN. (AB).

24598 (NEI-DK–1102, pp. 49-61) **Summary of 19. NATO/CCMS international technical meeting (ITM) round table discussion on the harmonization of atmospheric dispersion models.** Irwin, J.S. (Atmospheric Sciences Modeling Division, Air Resources Laboratory, National Oceanic and Atmospheric Administration, (United States)). Dansk Center for Atmosfaereforskning (DCAR), Roskilde (Denmark). 1992. (CONF-9205345–: Workshop on objectives for next generation of practical short-range atmospheric dispersion models, Roskilde (Denmark), 6-8 May 1992). In *Objectives for next generation of practical short-range atmospheric dispersion models: Proceedings of the workshop.* [271p.] Order Number DE93625642. Source: OSTI; NTIS; INIS.

A Round Table discussion was held at the 19th NATO/CCMS Conference on Atmospheric Dispersion with participation of approximately 50 scientists involved with various aspects of air quality assessment from over 15 countries. The premise of discussion was there is a need within the European Countries to provide a basis for developing an approach towards harmonization of air quality modeling. The term "harmonization" was used mostly in the sense that for the same input a simulation model would compute the same output. Concern was expressed that this usage was overly simplistic, prohibitively restrictive and counterproductive. The main benefits of achieving harmonization were 1) proper use of available meteorological data and 2) consistent treatment of source impacts throughout the European Community. The challenge before the European Community is to resolve in a realistic manner the problem of assessing environmental impacts in a manner that is fair throughout the European Community and proper within the scientific community. The resolution will involve compromises between 'being fair' and 'being state-of-the-science'. Accuracy and realism may be willingly sacrificed in order to achieve fairness. Developing consensus on how and what is to be achieved in the process of harmonization will involve difficult value judgments. But the consensus process should be encouraged given the significant and worthwhile benefits. (au).

24599 (NEI-DK–1102, pp. 63-75) **Improving practical atmospheric dispersion models: The scientific basis.** Hunt, J.C.R. (U.K. Meteorological Office, Bracknell (United Kingdom)); Hudson, B.; Thomson, D.J. Dansk Center for Atmosfaereforskning (DCAR), Roskilde (Denmark). 1992. (CONF-9205345–: Workshop on objectives for next generation of practical short-range atmospheric dispersion models, Roskilde (Denmark), 6-8 May 1992). In *Objectives for next generation of practical short-range atmospheric dispersion models: Proceedings of the workshop.* [271p.] Order Number DE93625642. Source: OSTI; NTIS; INIS.

The new generation of practical atmospheric dispersion model (for short range $\leq$ 30 km) are based on dispersion science and boundary layer meteorology which have widespread international acceptance. In addition, recent improvements in computer skills and the widespread availability of small powerful computers make it possible to have new regulatory models which are more complex than the previous generation which were based on charts and simple formulae. This paper describes the basis of these models and how they have developed. Such models are needed to satisfy the

urgent public demand for sound, justifiable and consistent environmental decisions. For example, it is preferable that the same models are used to simulate dispersion in different industries; in many countries at present different models are used for emissions from nuclear and fossil fuel power stations. The models should not be so simple as to be suspect but neither should they be too complex for widespread use; for example, at public inquiries in Germany, where simple models are mandatory, it is becoming usual to cite the results from highly complex computational models because the simple models are not credible. This paper is written in a schematic style with an emphasis on tables and diagrams. (au) (22 refs.).

24600 (NEI-DK–1102, pp. 77-85) **Effects of data limitations on hopes for improved short range atmospheric dispersion models.** Hanna, S.R. (Sigma Research Corporation, Concord, MA (United States)). Dansk Center for Atmosfaereforskning (DCAR), Roskilde (Denmark). 1992. (CONF-9205345–: Workshop on objectives for next generation of practical short-range atmospheric dispersion models, Roskilde (Denmark), 6-8 May 1992). In *Objectives for next generation of practical short-range atmospheric dispersion models: Proceedings of the workshop.* [271p.] Order Number DE93625642. Source: OSTI; NTIS; INIS.

The author identifies areas in which short-range dispersion models, in relation to air pollution, can be improved. Emphasis is on boundary layer parameterizations, which feed directly into plume rise and dispersion algorithms. The topics of mixing depth, vertical profiles of turbulence temperature and wind speed, the formation of the nocturnal jet, non-steady state periods, surface constants, moisture parameters, roughness length, surface energy balance relations and Lagrangian time scales are dealt with. (AB).

24601 (NEI-DK–1102, pp. 87-94) **Harmonization in the preprocessing of meteorological data for dispersion models.** Thompson, N. (Meteorological Office, Bracknell (United Kingdom)). Dansk Center for Atmosfaereforskning (DCAR), Roskilde (Denmark). 1992. (CONF-9205345–: Workshop on objectives for next generation of practical short-range atmospheric dispersion models, Roskilde (Denmark), 6-8 May 1992). In *Objectives for next generation of practical short-range atmospheric dispersion models: Proceedings of the workshop.* [271p.] Order Number DE93625642. Source: OSTI; NTIS; INIS.

It is suggested that the National Meteorological Services should attempt to coordinate the methods they will use to provide the data for predicting atmospheric dispersion models regarding air pollution. Standard data need significant processing in order to provide the fundamental parameters which will eventually represent meteorological influences in all methods of dispersion prediction. The paper outlines a framework intended to lead to uniform responses to the requirements of dispersion modellers'. (AB).

24602 (NEI-DK–1102, pp. 99-107) **Boundary layer parameterizations and long-range transport.** Irwin, J.S. (Atmospheric Sciences Modeling Division, Air Resources Laboratory, National Oceanic and Atmospheric Administration, NC (United States)). Dansk Center for Atmosfaereforskning (DCAR), Roskilde (Denmark). 1992. (CONF-9205345–: Workshop on objectives for next generation of practical short-range atmospheric dispersion models, Roskilde (Denmark), 6-8 May 1992). In *Objectives for next generation of practical short-range atmospheric dispersion models: Proceedings of the workshop.* [271p.] Order Number DE93625642. Source: OSTI; NTIS; INIS.

A joint work group between the American Meteorological Society (AMS) and the EPA is perusing the construction of an air quality model that incorporates boundary layer parameterizations of dispersion and transport. This model could replace the currently accepted model, the Industrial Source Complex (ISC) model. The ISC model is a Gaussian-plume multiple point-source model that provides for consideration of fugitive emissions, aerodynamic wake effects, gravitational settling and dry deposition. A work group of several Federal and State agencies is perusing the construction of an air quality modeling system for use in assessing and tracking visibility impairment resulting from long-range transport of pollutants. The modeling system is designed to use the hourly vertical profiles of wind, temperature and moisture resulting from a mesoscale meteorological processor that employs four dimensional data assimilation (FDDA). FDDA involves adding forcing functions to the governing model equations to gradually "nudge" the model state toward the observations (12-hourly upper air observations of wind, temperature and moisture, and 3-hourly surface observations of wind and moisture). In this way it is possible to generate data sets whose accuracy, in terms of transport, precipitation, and dynamic consistency is superior to both direct interpolation of synoptic-scale analyses of observations and purely predictive mode model result. (AB) (19 refs.).

24603 (NEI-DK–1102, pp. 109-130) **Atmospheric dispersion models for real-time application in the decision support system being developed within the CEC.** Mikkelsen, T. (Department of Meteorology and Wind Energy, Risoe National Laboratory, Roskilde (Denmark)). Dansk Center for Atmosfaereforskning (DCAR), Roskilde (Denmark). 1992. (CONF-9205345–: Workshop on objectives for next generation of practical short-range atmospheric dispersion models, Roskilde (Denmark), 6-8 May 1992). In *Objectives for next generation of practical short-range atmospheric dispersion models: Proceedings of the workshop.* [271p.] Order Number DE93625642. Source: OSTI; NTIS; INIS.

A number of Commission of the European Communities member states are presently coordinating their research and development of a "Real-time On-line DecisiOn Support" (RODOS) for emergency assistance in the event of nuclear accident. In addition to atmospheric dispersion, the system involves multiple other radiological disciplines. The ability to estimate a specific atmospheric dispersion scenarios in real-time becomes a first-priority task and is of uttermost importance for the subsequent success or failure of such a comprehensive decision support system to guide off-site emergency situations. No single dispersion model is at present able to cover all possible release-types and scales of dispersion. A hierarchy of atmospheric flow and dispersion models is presently being ranked for suitability to real-time calculate air and integrated-air concentrations. Starting at the short-range scale, models are discriminated with respect to principle, adequacy and flexibility, CPU-time constraints, experimental evaluation record, instantaneous or short-time release handling, deposition measures (wet and dry), input and output data flexibility and uncertainty-handling and model-interpretation. Additional features of particular importance are: Robustness in schemes for meteorological preprocessing of meteorological input data, and on-line backfitting and data-assimilation procedures. Models demonstrating practical and operational use, including real-time operational experience, have in this context the highest priority, as opposed to the more sophisticated and theoretical "development-type" models. Real-time methods founded on our present knowledge and data concerning flow and dispersion in the atmospheric boundary layer, are of primary interest. (au) (18 refs.).

24604 (NEI-DK–1102, pp. 191-193) **Summary of a UK meeting to discuss harmonisation of atmospheric dispersion models.** Jones, J.A. (National Radiological Protection Board, Chilton, Didcot, Oxon (United Kingdom)). Dansk Center for Atmosfaereforskning (DCAR), Roskilde (Denmark). 1992. (CONF-9205345–: Workshop on objectives for next generation of practical short-range atmospheric dispersion models, Roskilde (Denmark), 6-8 May 1992). In *Objectives for next generation of practical short-range atmospheric dispersion models: Proceedings of the workshop.* [271p.] Order Number DE93625642. Source: OSTI; NTIS; INIS.

Short communication. AIR POLLUTION/mathematical models; CONTAMINATION/mathematical models; COMPUTERIZED SIMULATION; CONTAMINATION; DISPERSIONS; EARTH ATMOSPHERE; FORECASTING; REACTOR LICENSING; STANDARDIZATION; UNITED KINGDOM

24605 (NEI-DK–1102, pp. 131-138) **Quality criteria for air pollution models, standardisation and model development in the Netherlands.** Noordijk, H. (National Institute of Public Health and Environmental Protection (RIVM), Bilthoven (Netherlands)). Dansk Center for Atmosfaereforskning (DCAR), Roskilde (Denmark). 1992. (CONF-9205345–: Workshop on objectives for next generation of practical short-range atmospheric dispersion models, Roskilde (Denmark), 6-8 May 1992). In *Objectives for next generation of practical short-range atmospheric dispersion models:*

Proceedings of the workshop. [271p.] Order Number DE93625642. Source: OSTI; NTIS; INIS.

Based on standards of EPA and IEEE, quality criteria have been formulated which address the development of air pollution models, the transformation towards user-friendly software and "after-sales" service. A Dutch standard on the description of air pollution models is being finalized. The standard formulates minimal requirements on the theoretical and practical description of models. This paper provides a survey of the quality criteria and it summarizes the standard. Further, the current practice of model development at RIVM is discussed. (au) (24 refs.).

24606 (NEI-DK–1102, pp. 139) **Atmospheric dispersion modelling as a tool for regulatory bodies in Israel: Trends and experience.** Dayan, U. (Soreq Nuclear Research Center, Yavne (Israel)); Mahrer, Y. Dansk Center for Atmosfaereforskning (DCAR), Roskilde (Denmark). 1992. (CONF-9205345–: Workshop on objectives for next generation of practical short-range atmospheric dispersion models, Roskilde (Denmark), 6-8 May 1992). In *Objectives for next generation of practical short-range atmospheric dispersion models: Proceedings of the workshop.* [271p.] Order Number DE93625642. Source: OSTI; NTIS; INIS.

Short communication. AIR POLLUTION/dispersions; DISPERSIONS; COMPUTERIZED SIMULATION; EARTH ATMOSPHERE; ISRAEL; MATHEMATICAL MODELS

24607 (NEI-DK–1102, pp. 143-146) **UK-ADMS - a new approach to modelling dispersion in the earth's atmospheric boundary layer.** Carruthers, D.J. (Cambridge Environmental Research Consultants Ltd. (United Kingdom)); Holroyd, R.J.; Weng, W.S.; Robins, A.G.; Apsley, D.D.; Thomson, D.J.; Smith, F.B.; Hunt, J.C.R. Dansk Center for Atmosfaereforskning (DCAR), Roskilde (Denmark). 1992. (CONF-9205345–: Workshop on objectives for next generation of practical short-range atmospheric dispersion models, Roskilde (Denmark), 6-8 May 1992). In *Objectives for next generation of practical short-range atmospheric dispersion models: Proceedings of the workshop.* [271p.] Order Number DE93625642. Source: OSTI; NTIS; INIS.

The UK Atmospheric Dispersion Modelling System is described in considerable detail. The principle modules are dealt with. A key to the methodology is that vertical profiles of mean velocity, temperature and turbulence in the boundary layer depend on the relative values of the height above the ground, the height of the boundary layer, and a length scale determined by the friction velocity and the heat flux and air temperature at the surface. The models can be used at any location. (AB) (15 refs.).

24608 (NEI-DK–1102, pp. 147-148) **The Danish OML model.** Olesen, H.R. (National Environmental Research Institute (NERI), Roskilde (Denmark)). Dansk Center for Atmosfaereforskning (DCAR), Roskilde (Denmark). 1992. (CONF-9205345–: Workshop on objectives for next generation of practical short-range atmospheric dispersion models, Roskilde (Denmark), 6-8 May 1992). In *Objectives for next generation of practical short-range atmospheric dispersion models: Proceedings of the workshop.* [271p.] Order Number DE93625642. Source: OSTI; NTIS; INIS.

Short communication. AIR POLLUTION/dispersions; DISPERSIONS; COMPUTERIZED SIMULATION; DENMARK; EARTH ATMOSPHERE; MATHEMATICAL MODELS; PLUMES

24609 (NEI-DK–1102, pp. 149-150) **The Belgian immission frequency distribution model IFDM.** Cosemans, G. (VITO, Mol (Belgium)); Kretzschmar, J.; Maes, G. Dansk Center for Atmosfaereforskning (DCAR), Roskilde (Denmark). 1992. (CONF-9205345–: Workshop on objectives for next generation of practical short-range atmospheric dispersion models, Roskilde (Denmark), 6-8 May 1992). In *Objectives for next generation of practical short-range atmospheric dispersion models: Proceedings of the workshop.* [271p.] Order Number DE93625642. Source: OSTI; NTIS; INIS.

During the years 1973-1985, the IFDM-model has involved according to the needs of as well practical work such as permit granting and emission granting policy evaluation in complex source regions, as of R and D-work on atmospheric dispersion. Recently, part of this model has been transferred to a Personal Computer, and a user's interface allowing for typical applications as needed for permit granting in the flat region of northern Belgium is nearly finished. (AU).

24610 (NEI-DK–1102, pp. 151) **Real-time dispersion modeling of accidental gas releases.** Coutinho, M. (Department of Enviroment and Planning, University of Aveiro, Aveiro (Portugal)); Conceicao, M.; Borrego, C.; Martins, J.M. Dansk Center for Atmosfaereforskning (DCAR), Roskilde (Denmark). 1992. (CONF-9205345–: Workshop on objectives for next generation of practical short-range atmospheric dispersion models, Roskilde (Denmark), 6-8 May 1992). In *Objectives for next generation of practical short-range atmospheric dispersion models: Proceedings of the workshop.* [271p.] Order Number DE93625642. Source: OSTI; NTIS; INIS.

Short communication. GASES/dispersions; AIR POLLUTION; COMPUTERIZED SIMULATION; EARTH ATMOSPHERE; GASES; DISPERSIONS; HAZARDOUS MATERIALS; INDUSTRIAL ACCIDENTS; MATHEMATICAL MODELS; PORTUGAL; TIME DEPENDENCE; TOXIC MATERIALS

24611 (NEI-DK–1102, pp. 153) **Analytical solutions of advection-diffusion equation as a tool for a next generation of atmospheric dispersion models.** Tirabassi, T. (FISBAT-CNR, Bologna (Italy)). Dansk Center for Atmosfaereforskning (DCAR), Roskilde (Denmark). 1992. (CONF-9205345–: Workshop on objectives for next generation of practical short-range atmospheric dispersion models, Roskilde (Denmark), 6-8 May 1992). In *Objectives for next generation of practical short-range atmospheric dispersion models: Proceedings of the workshop.* [271p.] Order Number DE93625642. Source: OSTI; NTIS; INIS.

Short communication. AIR POLLUTION/mathematical models; COMPUTERIZED SIMULATION; DISPERSIONS; EARTH ATMOSPHERE; TIME DEPENDENCE

24612 (NEI-DK–1102, pp. 155) **An easy to use semiempirical model for treating diffusion under weak wind conditions.** Cirillo, M.C. (ENEA, Roma (Italy)); Poli, A.A. Dansk Center for Atmosfaereforskning (DCAR), Roskilde (Denmark). 1992. (CONF-9205345–: Workshop on objectives for next generation of practical short-range atmospheric dispersion models, Roskilde (Denmark), 6-8 May 1992). In *Objectives for next generation of practical short-range atmospheric dispersion models: Proceedings of the workshop.* [271p.] Order Number DE93625642. Source: OSTI; NTIS; INIS.

Short communication. AIR POLLUTION/dispersions; DISPERSIONS; COMPUTERIZED SIMULATION; EARTH ATMOSPHERE; MATHEMATICAL MODELS; PLUMES; VELOCITY; WIND

24613 (NEI-DK–1102, pp. 165-166) **Large-eddy modelling as a data-base for practical air pollution models.** Nieuwstadt, F. (Delft University of Technology (Netherlands)). Dansk Center for Atmosfaereforskning (DCAR), Roskilde (Denmark). 1992. (CONF-9205345–: Workshop on objectives for next generation of practical short-range atmospheric dispersion models, Roskilde (Denmark), 6-8 May 1992). In *Objectives for next generation of practical short-range atmospheric dispersion models: Proceedings of the workshop.* [271p.] Order Number DE93625642. Source: OSTI; NTIS; INIS.

Short communication. AIR POLLUTION/mathematical models; COMPUTERIZED SIMULATION; DATA PROCESSING; DISPERSIONS; EARTH ATMOSPHERE; PLUMES; TURBULENCE; VORTEX FLOW; WIND

24614 (NEI-DK–1102, pp. 167) **The potential use of Lagrangian stochastic models for short-range dispersion.** Dop, H. van (Utrecht University (Netherlands)). Dansk Center for Atmosfaereforskning (DCAR), Roskilde (Denmark). 1992. (CONF-9205345–: Workshop on objectives for next generation of practical short-range atmospheric dispersion models, Roskilde (Denmark), 6-8 May 1992). In *Objectives for next generation of practical short-range atmospheric dispersion models: Proceedings of the workshop.* [271p.] Order Number DE93625642. Source: OSTI; NTIS; INIS.

Short communication. AIR POLLUTION/dispersions; DISPERSIONS; COMPUTERIZED SIMULATION; EARTH ATMOSPHERE;

LAGRANGIAN FUNCTION; MATHEMATICAL MODELS; PARTICULATES; PLUMES; STOCHASTIC PROCESSES; TURBULENCE

24615 (NEI-DK–1102, pp. 169-174) **Stochastic models for real time forecast and control of pollution episodes.** Finzi, G. (Centro Teoria dei Sistemi CNR, Dip. Elettronica e Informazione, Politecnico di Milano, Milan (Italy)). Dansk Center for Atmosfaereforskning (DCAR), Roskilde (Denmark). 1992. (CONF-9205345–: Workshop on objectives for next generation of practical short-range atmospheric dispersion models, Roskilde (Denmark), 6-8 May 1992). In *Objectives for next generation of practical short-range atmospheric dispersion models: Proceedings of the workshop.* [271p.] Order Number DE93625642. Source: OSTI; NTIS; INIS.

Mainly in polluted urban and industrial areas, a real-time prediction system has to be set up in order to be able to give the alarm whenever the forecast concentrations of sulfur dioxide etc. in the air exceed the legal limits, so that appropriate action can be taken in order to prevent critical episodes. A good tool for this purpose could be the class of "grey box" stochastic models for computerized simulation which make use of current and past concentration measures together with meteorological and emission data. The parameters of the model can assume different sets of values according to different categories in order to better simulate non-stationary behaviours of pollutant concentrations, mainly in situations of forthcoming critical episodes. The model is further described. (AB).

24616 (NEI-DK–1102, pp. 175) **The role of statistical models.** Chatwin, P.C. (University of Sheffield (United Kingdom)). Dansk Center for Atmosfaereforskning (DCAR), Roskilde (Denmark). 1992. (CONF-9205345–: Workshop on objectives for next generation of practical short-range atmospheric dispersion models, Roskilde (Denmark), 6-8 May 1992). In *Objectives for next generation of practical short-range atmospheric dispersion models: Proceedings of the workshop.* [271p.] Order Number DE93625642. Source: OSTI; NTIS; INIS.

Short communication. AIR POLLUTION/statistical models; ACCURACY; COMPUTERIZED SIMULATION; DISPERSIONS; EARTH ATMOSPHERE

24617 (NEI-DK–1102, pp. 177-185) **A regulator's perspective on the use of atmospheric dispersion models.** Williams, C.R. (Regulatory Standards Division, HM Inspectorate of Pollution (United Kingdom)). Dansk Center for Atmosfaereforskning (DCAR), Roskilde (Denmark). 1992. (CONF-9205345–: Workshop on objectives for next generation of practical short-range atmospheric dispersion models, Roskilde (Denmark), 6-8 May 1992). In *Objectives for next generation of practical short-range atmospheric dispersion models: Proceedings of the workshop.* [271p.] Order Number DE93625642. Source: OSTI; NTIS; INIS.

On 1 April 1991 a new regime for industrial pollution control was introduced in England and Wales: Integrated Pollution Regulation (IPR). For those industrial processes which involve releases of pollutants into the atmosphere, the relevant primary legislation includes: the Environmental Protection Act 1990, which established a system of Integrated Pollution Control for those industries which have the greatest potential to cause pollution, and the Radioactive Substances Act 1960, which is concerned with the regulation of radioactive releases. There is a requirement for the operator of a process to make an application to HMIP for authorization to operate the process and dispose of waste arisings, and an environmental impact assessment must form part of that application. HMIP does not prescribe the type of assessment techniques that the applicant should use. But the Inspectorate will audit the applicant's assessment, and also carry out its own calculations if appropriate. The assessment standards used by HMIP are being published in the form of "Chief Inspector's Guidance to Inspectors", which can be referred to by applicants. HMIP makes use of both short-range and longer-range atmospheric dispersion models to fulfill its regulatory duties. Within the former category, the Inspectorate is one of the UK organisations which is sponsoring the development of the UK-ADMS model. (AB).

24618 (NEI-DK–1102, pp. 187) **Model evaluation criteria using tracer experimental data.** Brusasca, G. (ENEL/DSR/CRTN, Milano (Italy)); Morselli, M.G.; Anfossi, D. Dansk Center for Atmosfaereforskning (DCAR), Roskilde (Denmark). 1992. (CONF-9205345–: Workshop on objectives for next generation of practical short-range atmospheric dispersion models, Roskilde (Denmark), 6-8 May 1992). In *Objectives for next generation of practical short-range atmospheric dispersion models: Proceedings of the workshop.* [271p.] Order Number DE93625642. Source: OSTI; NTIS; INIS.

Short communication. AIR POLLUTION/mathematical models; COMPARATIVE EVALUATIONS; DISPERSIONS; EARTH ATMOSPHERE; TRACER TECHNIQUES; VELOCITY; WIND

24619 (NEI-DK–1102, pp. 189-190) **Use of dispersion models in real time for environmental monitoring: A case study: The Sostanj experimental campaign.** Brusasca, G. (ENEL/DSR/CRTN, Milano (Italy)); Morselli, M.G.; Tinarelli, G.; Finardi, S. Dansk Center for Atmosfaereforskning (DCAR), Roskilde (Denmark). 1992. (CONF-9205345–: Workshop on objectives for next generation of practical short-range atmospheric dispersion models, Roskilde (Denmark), 6-8 May 1992). In *Objectives for next generation of practical short-range atmospheric dispersion models: Proceedings of the workshop.* [271p.] Order Number DE93625642. Source: OSTI; NTIS; INIS.

Short communication. AIR POLLUTION/dispersions; DISPERSIONS; COMPUTERIZED SIMULATION; EARTH ATMOSPHERE; GAUSSIAN PROCESSES; LAGRANGIAN FUNCTION; MATHEMATICAL MODELS; STOCHASTIC PROCESSES; THERMAL POWER PLANTS; VELOCITY; WIND

24620 (NEI-DK–1102, pp. 195-202) **Standards for the development of new dispersion models.** Robins, A. (National Power R and T, Bilton Centre, Leatherhead, Surrey (United Kingdom)). Dansk Center for Atmosfaereforskning (DCAR), Roskilde (Denmark). 1992. (CONF-9205345–: Workshop on objectives for next generation of practical short-range atmospheric dispersion models, Roskilde (Denmark), 6-8 May 1992). In *Objectives for next generation of practical short-range atmospheric dispersion models: Proceedings of the workshop.* [271p.] Order Number DE93625642. Source: OSTI; NTIS; INIS.

The key requirements of air pollution dispersion models used in the public domain are: clear objectives and limits to applicability, full and open documentation, unambiguous version control, openly reported performance evaluation and unrestricted use or availability. Model documentation must be openly available, either through the public domain or commercial spheres. It should be adequately detailed and supported by sufficient references for a third party to be able to create an effectively identical model. Unrestricted access must exist to either the model itself or to its use (through third parties). Version control must be sufficiently tight to identify unambiguously the actual model used in any particular application. The skill in developing standards and guidelines is to avoid the imposition of unnecessarily excessive overheads on model development. Simple tests for the level required can be based on the consequences of error in the final product or the economic value of decisions based on the application of the product. A particular problem lies in dealing in a reasonable manner with models currently in use. Here, the aim is to work towards the same overall standards through a form of backward quality assurance. Guidelines for model development are presented. (AB).

24621 (NEI-DK–1102, pp. 141) **Harmonization of French and German calculation schemes to model short-range atmospheric dispersion following accidental releases from nuclear power plants.** Massmeyer, K. (GRS mbH, Koeln (Germany)); Martens, R.; Crabol, B.; Romeo, E.; Nester, K.; Schnadt, H. Dansk Center for Atmosfaereforskning (DCAR), Roskilde (Denmark). 1992. (CONF-9205345–: Workshop on objectives for next generation of practical short-range atmospheric dispersion models, Roskilde (Denmark), 6-8 May 1992). In *Objectives for next generation of practical short-range atmospheric dispersion models: Proceedings of the workshop.* [271p.] Order Number DE93625642. Source: OSTI; NTIS; INIS.

Short communication. TRANSFRONTIER CONTAMINATION/earth atmosphere; COMPUTER CALCULATIONS; COMPUTERIZED SIMULATION; DATA PROCESSING; DISPERSIONS; FEDERAL REPUBLIC OF GERMANY; FRANCE; REACTOR ACCIDENTS; STANDARDIZATION

24622 (NEI-DK–1102, pp. 225-241) **Tracer experiment data sets for the verification of local and meso-scale atmospheric dispersion models including topographic effects: Acquisition, storage and distribution of the data sets.** Sartori, E. (OECD/NEA Data Bank, Issy les Moulineaux (France)); Schuler, W. Dansk Center for Atmosfaereforskning (DCAR), Roskilde (Denmark). 1992. (CONF-9205345–: Workshop on objectives for next generation of practical short-range atmospheric dispersion models, Roskilde (Denmark), 6-8 May 1992). In *Objectives for next generation of practical short-range atmospheric dispersion models: Proceedings of the workshop.* [271p.] Order Number DE93625642. Source: OSTI; NTIS; INIS.

Software and data for nuclear energy applications are acquired, tested and distributed by several information centres; in particular, relevant computer codes are distributed internationally by the OECD/NEA Data Bank (France) and by ESTSC and EPIC/RSIC (United States). This activity is coordinated among the centres and is extended outside the OECD area through an arrangement with the IAEA. This article proposes more specifically a scheme for acquiring, storing and distributing atmospheric tracer experiment data (ATE) required for verification of atmospheric dispersion models especially the most advanced ones including topographic effects and specific to the local and meso-scale. These well documented data sets will form a valuable complement to the set of atmospheric dispersion computer codes distributed internationally. Modellers will be able to gain confidence in the predictive power of their models or to verify their modelling skills. (au).

24623 (NEI-DK–1102, pp. 203-207) **The Dutch standard on the description of air pollution models.** Noordijk, H. (National Institute of Public Health and Environmental Protection (RIVM), Bilthoven (Netherlands)). Dansk Center for Atmosfaereforskning (DCAR), Roskilde (Denmark). 1992. (CONF-9205345–: Workshop on objectives for next generation of practical short-range atmospheric dispersion models, Roskilde (Denmark), 6-8 May 1992). In *Objectives for next generation of practical short-range atmospheric dispersion models: Proceedings of the workshop.* [271p.] Order Number DE93625642. Source: OSTI; NTIS; INIS.

This standard establishes requirements which the description of mathematical models for air quality has to meet. The standard is applicable to models which assist in calculating the concentration of compounds in the air and/or the deposition. Users should be able to judge the usefulness of a mathematical model for their own use on the basis of its description. This is often necessary for granting licences or policy planning. Equipment, software and other requirements are not given. The description of a mathematical model should give the user a good insight into the value of the model and the results obtained. To do this the field of application and the underlying scientific concepts should be clearly described. Besides the results of possible validation procedures the way in which broader acceptance is aimed at and the degree to which this is achieved has to be reflected. (au).

24624 (NEI-DK–1102, pp. 209-224) **Characteristics of a third generation regulatory models.** Kallos, G. (University of Athens, Department of Applied Physics, Meteorology Lab., Athens (Greece)); Pilinis, C.; Kassomenos, P.; Hatzakis, G. Dansk Center for Atmosfaereforskning (DCAR), Roskilde (Denmark). 1992. (CONF-9205345–: Workshop on objectives for next generation of practical short-range atmospheric dispersion models, Roskilde (Denmark), 6-8 May 1992). In *Objectives for next generation of practical short-range atmospheric dispersion models: Proceedings of the workshop.* [271p.] Order Number DE93625642. Source: OSTI; NTIS; INIS.

A new class of air pollution dispersion models has to be used for regulatory purposes in the future and they should have the following capabilities: Adequate spatial and temporal characterization of the PBL, wind and turbulence fields, enhancement and regionalization of existing air quality models to yield a model applicable on both urban and regional scales, adequate characterization of the chemical transformation of the gaseous pollutants in the atmosphere, adequate description of the dispersion and the physical changes of the toxic material released (i.e. evaporation and condensation), good description of the chemistry in aqueous phases, like fog and cloud chemistry, and accurate predictions of the removal processes of the gas and particulate matter (i.e. wet an dry deposition). Some of these model requirements are already satisfied in some research oriented models. In general, there is no unique model that satisfies all of the above, and even if it existed there is not the necessary database for such application and testing. The two major areas of development of regulatory modeling in the future, i.e. development of a complete meteorological and air quality model and development of the database capabilities for the routine application of the model, in the urban and rural areas of interest. With the computer power available in the near future, this kind of models will be able to be used even for emergency cases. (AB) (20 refs.).

24625 (NEI-DK–1143) **CO_2 technology: A literature study on the extraction and deposition of CO_2 from flue gases.** Matre, M. (Berdal Stroemme a.s. (Norway)); Olshausen, A.; Lindland, K. Nordisk Gasteknisk Center, Hoersholm (Denmark). Mar 1993. 59p. (In Norwegian). Order Number DE93794683. Source: OSTI; NTIS.

Extraction of carbon dioxide and deposition would be most feasible for large amounts of CO_2. This study is based on a 700 MWel gas-fired power station in use for 7400 hours per annum, producing 2.2 million tons CO_2 per annum. Absorption with amines, adsorption processes, use of seawater and use of chemicals are the methods of carbon dioxide extraction described. In the case of a absorption by amines, the gases are absorbed into a fluid. This process is the most promising so far for extracting CO_2 from fossil fuel flue gas. The most useful amines are Monoethanol and Diethanol. Adsorption is a separation process where gas or liquid comes in contact with a porous substance and components of the gas or liquid accumulate in that substance. It is expensive on account of the large quantities of exhaust gases. Use of seawater is a technically feasible method of removing CO_2, but requires very large quantities of water. There are several chemicals which combine with CO_2 more or less permanently but production of these requires so much energy, that a similar amount of CO_2 is produced. Recycling up to 40% of the exhaust gas will increase the CO_2 concentration and reduce the water and CO_2 content. This simplifies the extraction of CO_2. A pipeline is the best method for transporting 2.2 million tons of CO_2 as a gas or liquid with a typical pipeline pressure of 100 bar or more. Possibilities for depositing CO_2 are ocean disposal, depositing in aquifers, depositing in exhausted oil or gas reservoirs, land deposits and deposition in salt domes. These methods are described in detail. (AB) (42 refs.).

24626 (NEI-DK–1165) **Durability of fabric filters: Chemical influences. Literature survey. Performance.** Energiministeriets Energiforskningsprogram. Miljoe og restprodukter. Christiansen, K. Dk-TEKNIK, Soeborg (Denmark). Energi og Miljoe. Dec 1991. 64p. (In Danish). Contract ENS-1323/89-8. Order Number DE93794731. Source: OSTI; NTIS.

EFP-89.

Fabric filters used in connection with solid fuel combustion systems often have a very short service life because the bag tears or becomes hard. This could be caused by chemical processes on the surface and within the filter material. These aspects are described and discussed. Also described are specific tests of the fabric's susceptibility to nitrogen oxides and an investigation of hydrolysis of fabric materials. The performance/service life of fabric filters in actual cases of, for example, coal-fired, straw-fired and wood fuelled systems are examined and results are presented in detail. It was found that the most commonly used filter bags in the coal-fired systems observed were made of Dralon-T. Where 1 kg limestone is added per ton of coal these filters will last for two years. Nomex filter bags were most used in straw-fuelled plants and Dralon-T in wood-fuelled plants. Both of these types are composed of felt and last for about one year. Woven filter bags are seldom used because they deteriorate at high temperatures. (AB) (16 refs.).

24627 (NEI-DK–1176) **Methane reduction by catalysts for natural gas motors: Status report.** Boman, H. (Vattenfall Energisystem AB (Sweden)). Nordisk Gasteknisk Center, Hoersholm (Denmark). Mar 1993. 57p. (In Swedish). Order Number DE93794750. Source: OSTI; NTIS.

Methane comprises 80%-90% of the hydrocarbon exhaust emission from natural gas engines. The status of catalysator emission control technology, with the emphasis on methane, is described.

The description is based on a review of relevant literature and contacts with catalysator manufacturers. Excellent performance has been observed for several lean burn and stoichiometric converters but after only a few hours of aging the conversion performance is reduced in the case of most of the catalysts used for methane reduction. Gas engine manufacturers have mainly concentrated on controlling emissions of nitrogen oxides and carbon monoxide. Methane has been neglected in this respect because it does not play a role in ozone formation and because most methane in the atmosphere arises from natural biological sources. Future regulations will determine the extent of research and development within the field of methane reduction by catalysts but, it is stated, if they only control non-methane hydrocarbons, the reduction of methane emissions will probably not be necessary. (AB) (15 refs.).

24628 (NEI-DK–1179) **Integrated energy and environmental analyses.** Juul-Kristensen, B.; Emborg, L. Danmarks Tekniske Hoejskole, Lyngby (Denmark). Fysisk Lab. 3. Jun 1991. 107p. (In Danish). Order Number DE93794744. Source: OSTI; NTIS.

The publication takes the form of a resume and conclusions related to a series of analyses of the coordinated energy and environmental problems experienced in Denmark and the Nordic countries in general. A number of these studies concerned actual methods and tools of analysis. The method was to construct a number of scenarios of the Danish energy system in the year 2010. These were built up in such a way that it would be possible to choose a total energy system which, under specific degrees of social and technological development, satisfied certain environmental goals at the lowest possible cost. On this basis conclusions are made and the suitability of the working methods are discussed. Conclusions mainly concern the feasibility of general strategies for the reduction of carbon dioxide, sulphur dioxide and nitrogen oxides, through energy conservation, pollutive emission reduction and changing from district heating to natural gas cogeneration plants. Economical aspects are emphasised. It is stated that the transport sector contributes a significant amount to air pollution. The discussion is presented in considerable detail. (AB) (25 refs.).

24629 (NEI-FI–202) **Aulanko meeting on models to describe the geographic extent and time evolution of acidification and air pollution damage: Abstracts.** Ministry of the Environment, Helsinki (Finland). 1988. 73p. (CONF-8807220–: Seminar on models to describe the geographic extent and time evolution of acidification and air pollution damage, Haemeenlinna (Finland), 5-8 Jul 1988). Order Number DE93794807. Source: OSTI; NTIS.

Finnish Research Project on Acidification (HAPRO).

This report contains the proceedings of the meeting on models to describe the geographic extent and time evolution of acidification and air pollution damage. The meeting held is a part of the Finnish Research Project of Acidification, abbreviated as HAPRO: The topics covered include; sensitivity distributions, time evolution of regional impacts and uncertainty in model applications.

24630 (NREL/TP–430-5399) **Mercury emissions from municipal solid waste combustors: An assessment of the current situation in the United States and forecast of future emissions.** National Renewable Energy Lab., Golden, CO (United States); Solid Waste Association of North America, Silver Spring, MD (United States). May 1993. 107p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-83CH10093. Order Number DE93000100. Source: OSTI; NTIS; GPO Dep.

This report examines emissions of mercury (Hg) from municipal solid waste (MSW) combustion in the United States (US). It is projected that total annual nationwide MSW combustor emissions of mercury could decrease from about 97 tonnes (1989 baseline uncontrolled emissions) to less than about 4 tonnes in the year 2000. This represents approximately a 95 percent reduction in the amount of mercury emitted from combusted MSW compared to the 1989 mercury emissions baseline. The likelihood that routinely achievable mercury emissions removal efficiencies of about 80 percent or more can be assured; it is estimated that MSW combustors in the US could prove to be a comparatively minor source of mercury emissions after about 1995. This forecast assumes that diligent measures to control mercury emissions, such as via use of supplemental control technologies (e.g., carbon adsorption), are generally employed at that time. However, no present consensus was found that such emissions control measures can be implemented industry-wide in the US within this time frame. Although the availability of technology is apparently not a limiting factor, practical implementation of necessary control technology may be limited by administrative constraints and other considerations (e.g., planning, budgeting, regulatory compliance requirements, etc.). These projections assume that: (a) about 80 percent mercury emissions reduction control efficiency is achieved with air pollution control equipment likely to be employed by that time; (b) most cylinder-shaped mercury-zinc (CSMZ) batteries used in hospital applications can be prevented from being disposed into the MSW stream or are replaced with alternative batteries that do not contain mercury; and (c) either the amount of mercury used in fluorescent lamps is decreased to an industry-wide average of about 27 milligrams of mercury per lamp or extensive diversion from the MSW stream of fluorescent lamps that contain mercury is accomplished.

24631 (ORNL/FTR–4221) **[International Atomic Energy Agency Coordinated Research Program on the Validation of Assessment Model Predictions for urban, aquatic, terrestrial, and multiple pathway systems, and the first technical meeting of the second phase of the International Biospheric Model Validation Study, in Austria]: Foreign trip report, February 28–March 14, 1992.** Barnthouse, L.W.; Blaylock, B.G.; Hoffman, F.O.; Trabalka, J.R. Oak Ridge National Lab., TN (United States). 14 Apr 1992. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93011242. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The International Atomic Energy Agency (IAEA) and the International Biospheric Model Validation Study (BIOMOVS) provide an opportunity for scientists around the world to test the validity of assumptions, parameters, and perditions of mathematical models used for environmental radiological assessments. The IAEA has a coordinated research program called the Validation of Assessment Model Predictions which involves model testing in the urban, terrestrial, and aquatic environments. VAMP includes a special working group concerned with testing model predictions of the transfer of radionuclides from an initial deposition through multiple exposure pathways. The travelers actively participated in the VAMP multiple pathways working group; explored opportunities for broadening the scope BIOMOVS II to include nonradiological contaminants and ecological endpoints; and developed collaborative model testing efforts with scientists from eastern Europe and the former Soviet Union.

24632 (ORNL/TM–11212) **Disposal of chemical agents and munitions stored at Umatilla Depot Activity, Hermiston, Oregon: Final Phase 1 environmental report.** Zimmerman, G.P.; Hillsman, E.L.; Johnson, R.O.; Miller, R.L.; Patton, T.G.; Schoepfle, G.M.; Tolbert, V.R.; Feldman, D.L.; Hunsaker, D.B. Jr.; Kroodsma, R.L.; Morrissey, J.; Rickert, L.W.; Staub, W.P.; West, D.C. Oak Ridge National Lab., TN (United States). Feb 1993. 176p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93013452. Source: OSTI; NTIS; GPO Dep.

The Umatilla Depot Activity (UMDA) near Hermiston, Oregon, is one of eight US Army installations in the continental United States where lethal unitary chemical agents and munitions are stored, and where destruction of agents and munitions is proposed under the Chemical Stockpile Disposal Program (CSDP). The chemical agent inventory at UMDA consists of 11.6%, by weight, of the total US stockpile. The destruction of the stockpile is necessary to eliminate the risk to the public from continued storage and to dispose of obsolete and leaking munitions. In 1988 the US Army issued a Final Programmatic Environmental Impact Statement (FPEIS) for the CSDP that identified on-site disposal of agents and munitions as the environmentally preferred alternative (i.e., the alternative with the least potential to cause significant adverse impacts), using a method based on five measures of risk for potential human health and ecosystem/environmental effects; the effectiveness and adequacy of emergency preparedness capabilities also played a key role in the FPEIS selection methodology. In some instances, the FPEIS included generic data and assumptions that were developed to allow a consistent comparison of potential impacts among programmatic alternatives and did not include detailed conditions at

each of the eight installations. The purpose of this Phase 1 report is to examine the proposed implementation of on-site disposal at UMDA in light of more recent and more detailed data than those included in the FPEIS. Specifically, this Phase 1 report is intended to either confirm or reject the validity of on-site disposal for the UMDA stockpile. Using the same computation methods as in the FPEIS, new population data were used to compute potential fatalities from hypothetical disposal accidents. Results indicate that onsite disposal is clearly preferable to either continued storage at UMDA or transportation of the UMDA stockpile to another depot for disposal.

24633 (PNL–3826) **Atmospheric radionuclide concentrations measured by Pacific Northwest Laboratory since 1961.** Young, J.A.; Thomas, C.W. Pacific Northwest Lab., Richland, WA (United States). Mar 1981. 273p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93008062. Source: OSTI; NTIS; GPO Dep.

The atmospheric concentrations of a wide spectrum of radionuclides produced by nuclear weapons, nuclear reactors, cosmic rays, radon and thoron decay and the SNAP-9A burn-up (^{238}Pu) have been measured at Richland, Washington, since 1961; at Barrow, Alaska, since 1964; and at other stations for shorter periods of time. There has been considerable concern over the health hazard presented by these radionuclides, but it has also been recognized that atmospheric mixing and deposition rates can be determined from their measurement. Therefore, Pacific Northwest Laboratory began the continuous measurement of the atmospheric concentrations of a wide spectrum of radionuclides produced by nuclear weapons, nuclear reactors, cosmic rays, and radon and thoron decay. This report will discuss the concentrations of the longer-lived radionuclides (T 1/2 > 12 days). The concentrations of shorter-lived radionuclides measured following Chinese nuclear tests since 1972 are discussed in another report.

24634 (PNL-SA–20914) **A parameterization of cloud droplet nucleation.** Ghan, S.J. (Pacific Northwest Lab., Richland, WA (United States)); Chuang, C.; Penner, J.E. Pacific Northwest Lab., Richland, WA (United States). Jan 1993. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-930142–4: 4. American Meteorological Society (AMS) symposium on global change studies, Anaheim, CA (United States), 14-19 Jan 1993). Order Number DE93007998. Source: OSTI; NTIS; INIS; GPO Dep.

Droplet nucleation is a fundamental cloud process. The number of aerosols activated to form cloud droplets influences not only the number of aerosols scavenged by clouds but also the size of the cloud droplets. Cloud droplet size influences the cloud albedo and the conversion of cloud water to precipitation. Global aerosol models are presently being developed with the intention of coupling with global atmospheric circulation models to evaluate the influence of aerosols and aerosol-cloud interactions on climate. If these and other coupled models are to address issues of aerosol-cloud interactions, the droplet nucleation process must be adequately represented. Here we introduce a droplet nucleation parametrization that offers certain advantages over the popular Twomey (1959) parameterization.

24635 (PNL-SA–21377) **Boundary layer structure over areas of heterogeneous heat fluxes.** Doran, J.C. (Pacific Northwest Lab., Richland, WA (United States)); Barnes, F.J.; Coulter, R.L.; Crawford, T.L. Pacific Northwest Lab., Richland, WA (United States). Jan 1993. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830 ;W-31109-ENG-38 ;W-7405-ENG-36. (CONF-930142–5: 4. American Meteorological Society (AMS) symposium on global change studies, Anaheim, CA (United States), 14-19 Jan 1993). Order Number DE93007887. Source: OSTI; NTIS; INIS; GPO Dep.

In general circulation models (GCMs), some properties of a grid element are necessarily considered homogeneous. That is, for each grid volume there is associated a particular combination of boundary layer depth, vertical profiles of wind and temperature, surface fluxes of sensible and latent heat, etc. In reality, all of these quantities may exhibit significant spatial variations the grid area, and the larger the area the greater the likely variations. In balancing the benefits of higher resolution against increased computational time and expense, it is useful to consider what the consequences of such subgrid-scale variability may be. Moreover, in interpreting the results of a simulation, one must be able to define an appropriate average value over a grid. There are two aspects of this latter problem: (1) in observations, how does one take a set of discrete or volume-averaged measurements and relate these to properties of the entire domain, and (2) in computations, how can subgrid-scale features be accounted for in the model parameterizations? To address these and related issues, two field campaigns were carried out near Boardman, Oregon, in June 1991 and 1992. These campaigns were designed to measure the surface fluxes of latent and sensible heat over adjacent areas with strongly contrasting surface types and to measure the response of the boundary layer to those fluxes. This paper discusses some initial findings from those campaigns.

24636 (PNL-SA–21478) **A paleoscience approach to estimating the effects of climatic warming on salmonid fisheries of the Columbia River Basin.** Chatters, J.C.; Butler, V.L.; Scott, M.J.; Anderson, D.M.; Neitzel, D.A. Pacific Northwest Lab., Richland, WA (United States). Oct 1992. 22p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-9210326–1: Pacific Science Organization international symposium, Vancouver (Canada), 13-16 Oct 1992). Order Number DE93008991. Source: OSTI; NTIS; GPO Dep.

To understand how climatic warming might affect salmonid populations, we are following a four-step procedure, incorporating paleoenvironmental data at the beginning and ending points, as follows. First, we used geomorphic, paleobotanical, and paleomalacological data to reconstruct stream conditions during the last 8000 years. Second, we estimated the effect on salmon of conditions extant approximately 6000 to 7000 radiocarbon years before present (B.P.), when temperatures were as much as 2°C warmer than at present. This became an analog of future warmer climate and its effects on spawning, incubation, and rearing parameters of the NPPC's Tributary Parameter Model (TPM) for estimating salmoned production. Third, we ran the TPM in conjunction with the NPPC System Planning Model (SPM) to calculate the effect of these analog conditions on the population of returning adult fish in selected stream systems. Ultimately, we will run the models for all salmon-accessible subbasins of the Columbia River system. Finally, we are identifying fish remains obtained from archaeological sites along the Columbia River to compare variations in the taxonomic composition of ancient fish assemblages with model predictions.

24637 (PNL-SA–21486) **Binary homogeneous nucleation: Temperature and relative humidity fluctuations and nonlinearity.** Easter, R.C. (Pacific Northwest Lab., Richland, WA (United States)); Peters, L.K. Pacific Northwest Lab., Richland, WA (United States). Jan 1993. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-930133–9: 73. American Meteorological Society (AMS) annual meeting, Anaheim, CA (United States), 17-22 Jan 1993). Order Number DE93007884. Source: OSTI; NTIS; INIS; GPO Dep.

This report discusses binary homogeneous nucleation involving H_2SO_4 and water vapor is thought to be the primary mechanism for new particle formation in the marine boundary layer. Temperature, relative humidity, and partial pressure of H_2SO_4 vapor are the most important parameters in fixing the binary homogeneous nucleation rate in the H_2SO_4/H_2O system. The combination of thermodynamic calculations and laboratory experiments indicates that this rate varies roughly as the tenth power of the saturation ratio of H_2SO_4 vapor. Furthermore, the vapor pressure of H_2SO_4 is a function of temperature, and similar dependencies of the binary homogeneous nucleation rate on relative humidity can be noted as well. These factors thus introduce strong non-linearities into the system, and fluctuations of temperature, relative humidity, and H_2SO_4 vapor concentrations about mean values may strongly influence the nucleation rate measured in the atmosphere.

24638 (PNL-SA–21492) **Spatial and temporal variability of precipitation and chemistry: Case studies from the Frontal Boundary Study.** Dana, M.T. Pacific Northwest Lab., Richland, WA (United States). Jan 1993. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-930133–10: 73. American Meteorological Society (AMS)

annual meeting, Anaheim, CA (United States), 17-22 Jan 1993). Order Number DE93007883. Source: OSTI; NTIS; INIS; GPO Dep.

Regional and larger-scale models of pollutant transport and deposition generally, by practical necessity, must be limited in output of precipitation rate and chemical composition to values for selected time intervals representing areas on the order of 10^4 km^2. Naturally, it is of some concern that these values be reasonably representative of natural variations both in time and space. This question may be approached through field studies involving detailed spatial (using a network of samplers on the model grid scale) and temporal (using sequential sampling) measurements. This paper presents an initial analysis, using simple statistical concepts, of data bases from such a field study, the Frontal Boundary Study (FBS).

24639 (PNL-SA–21966) **Development of a balloon-borne stabilized platform for measuring radiative flux profiles in the atmospheric boundary layer.** Whiteman, C.D.; Alzheimer, J.M.; Anderson, G.A.; Shaw, W.J. Pacific Northwest Lab., Richland, WA (United States). Mar 1993. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-9303122–2: 3. ARM science team meeting, Norman, OK (United States), 1-5 Mar 1993). Order Number DE93013186. Source: OSTI; NTIS; GPO Dep.

A stabilized platform has been developed to carry broadband short-wave and long-wave radiometric sensors on the tether line of a small tethered balloon that ascends through atmospheric depths of up to 1.5 km to obtain vertical profiles of radiative flux and flux divergence for evaluating atmospheric radiative transfer models. The Sky Platform was designed to keep the radiometers level despite unpredictable movements of the balloon and tether line occasioned by turbulence and wind shear. The automatic control loop drives motors, gears, and pulleys located on two of the vertices of the triangular frame to climb the harness lines to keep the platform level. Radiometric sensors, an electronic compass, and an onboard data acquisition system make up the remainder of the Sky Platform. Because knowledge of the dynamic response of the tether line-platform system is essential to properly close the automatic control loop on the Sky Platform, a Motion Sensing Platform (MSP) was developed to fly in place of the Sky Platform on the tether line to characterize the Sky Platform's operating environment. This unstabilized platform uses an array of nine solid-state linear accelerometers to measure the lateral and angular accelerations, velocities, and displacements that the Sky Platform will experience. This paper presents field performance tests of the Sky and Motion Sensing Platforms, as conducted at Richland, Washington, on February 17, 1993. The tests were performed primarily to characterize the stabilization system on the Sky Platform. Test flights were performed on this cold winter day from 1400 to 1800 Pacific Standard Time (PST). During this period, temperature profiles were near the dry adiabatic lapse rate. Flights were made through a jet wind speed profile having peak wind speeds of 7 m/s at a height of 100 m AGL. Wind directions were from the northwest. All flights were performed as continuous ascents, rather than ascending in discrete steps with halts at set altitudes.

24640 (PNL-SA–22394) **A review of the global emissions, transport, and effects of heavy metals in the environment: Handout.** Friedman, J.R.; Ashton, W.B.; Rapoport, R.D. Pacific Northwest Lab., Richland, WA (United States). May 1993. 38p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93013507. Source: OSTI; NTIS; GPO Dep.

The purpose of this report is to describe the current state of knowledge regarding the sources and quantities of heavy metal emissions, their transport and fate, their potential health and environmental effects, and strategies to control them. The approach is to review the literature on this topic and to consult with experts in the field. Ongoing research activities and research needs are discussed.

24641 (SAND–93-8558C) **A laser-based technique to continuously monitor metal aerosol emissions.** Flower, W.L. (Sandia National Labs., Livermore, CA (United States)); Peng, L.W.; French, N.B.; Johnsen, H.A.; Ottesen, D.K.; Renzi, R.F.: Westbrook, L.V.; Bonin, M.P. Sandia National Labs., Livermore, CA (United States). [1993]. 19p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DR00789. (CONF-9305183–1: EPRI workshop, Scottsdale, AZ (United States), 19-22 May 1993). Order Number DE93012836. Source: OSTI; NTIS; INIS; GPO Dep.

Sandia National Laboratories is developing an instrument to continuously monitor metal aerosol emissions. Applications for this monitor range from industrial process vents (e.g., exhaust stacks from electroplating baths) to waste treatment processes (incinerators), to boilers and industrial furnaces (coal-fired power plants). The monitoring technique is based on Laser Spark Spectroscopy (LASS; also known as Laser-Induced Breakdown Spectroscopy – LIBS), in which a pulsed laser is used to rapidly heat a particle and produce a plasma (or laser "spark"). The light emission from the spark is spectrally resolved and analyzed to identify the elemental constituents of the particle and quantify the abundance of the measured species. One feature of LASS is that it can measure atomic species embedded in either solid particles or fine liquid droplets, which account for a large percentage of metal emissions from applications of interest. Presented here are a description of the technique and initial results from laboratory simulations to determine sensitivity and to establish calibration procedures. Our project is currently focused on measuring chromium emissions from electroplating baths. This work forms the basis for future applications to incineration and fossil power plants since chromium is one of the more toxic metals under regulation by the Clean Air Act.

24642 (SCPRI-RM–12-1992) **Monthly results of measurements; December 1992.** Service Central de Protection contre les Rayonnements Ionisants, 78 - Le Vesinet (France). 1992. [62p.] (In French). Order Number DE93625786. Source: OSTI; NTIS (US Sales Only); INIS.

This report of the SCPRI exposes the principal results concerning the routine monitoring of environmental radioactivity in France: atmospheric dusts, rainwater, surface water, underground water, sewage water, drinking water, food chain (milk, vegetables, fishes), sea water around nuclear sites and other sites. The activities of various radioisotopes are presented in tables.

24643 (UCRL-ID–108158) **A modeling perspective on cloud radiative forcing.** Potter, G.L. (Lawrence Livermore National Lab., CA (United States)); Corsetti, L.; Slingo, J.M.; Morcrette, J.J. Lawrence Livermore National Lab., CA (United States). Feb 1993. 24p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (PCMDI–9). Order Number DE93012383. Source: OSTI; NTIS; INIS; GPO Dep.

Radiation fields from a perpetual July integration of a T106 version of the ECM-WF operational model are used to identify the most appropriate way to diagnose cloud radiative forcing in a general circulation model, for the purposes of intercomparison between models. Differences between the Methods I and II of Cess and Potter (1987) and a variant method are addressed. Method I is shown to be the least robust of all methods, due to the potential uncertainties related to persistent cloudiness, length of the sampling period and biases in retrieved clear-sky quantities due to insufficient sampling of the diurnal cycle. Method II is proposed as an unambiguous way to produce consistent radiative diagnostics for intercomparing model results. The impact of the three methods on the derived sensitivities and cloud feedbacks following an imposed change in sea surface temperature is discussed. The sensitivity of the results to horizontal resolution is considered by using the diagnostics from parallel integrations with T21 version of the model.

24644 (UCRL-ID–111532) **AMIP: The Atmospheric Model Intercomparison Project.** Gates, W.L. Lawrence Livermore National Lab., CA (United States). Sep 1992. 20p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE93007413. Source: OSTI; NTIS; GPO Dep.

The Atmospheric Model Intercomparison Project (AMIP) is an international effort to determine the systematic climate errors of atmospheric models under realistic conditions, and calls for the simulation of the climate of the decade 1979–1988 using the observed monthly-averaged distributions of sea-surface temperature and sea ice as boundary conditions. Organized by the Working Group on Numerical Experimentation (WGNE) of the World Climate

Resource Programme, AMEP involves the international atmospheric modeling community in a major test and intercomparison of model performance; in addition to an agreed-to set of monthly averaged output variables, each of the participating models will generate a daily history of state. These data will be stored and made available in standard format by the Program for Climate Model Diagnosis and Intercomparison (PCMDI) at the Lawrence Livermore National Laboratory. Following completion of the computational phase of AMEP in 1993, emphasis will shift to a series of diagnostic subprojects, now being formed, for the detailed examination of model performance and the simulation of specific physical processes and phenomena. AMIP offers an unprecedented opportunity for the comprehensive evaluation and validation of current atmospheric models, and is expected to provide valuable information for model improvement.

24645 (UCRL-ID–111532-Rev.1) **AMIP: The Atmospheric Model Intercomparison Project: Program for Climate Model Diagnosis and Intercomparison: Revision 1.** Gates, W.L. Lawrence Livermore National Lab., CA (United States). Dec 1992. 20p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (PCMDI–7). Order Number DE93007400. Source: OSTI; NTIS; GPO Dep.

The Atmospheric Model Intercomparison Project (AMIP) is an international effort to determine the systematic climate errors of atmospheric models under realistic conditions, and calls for the simulation of the climate of the decade 1979–1988 using the observed monthly-averaged distributions of sea-surface temperature and sea ice as boundary conditions. Organized by the Working Group on Numerical Experimentation (WGNF) as a contribution to the World Climate Research Programme, AMIEP involves the international atmospheric modeling community in a major test and intercomparison of model performance; in addition to an agreed-to set of monthly-averaged output variables, each of the participating models will generate a daily history of state. These data will be stored and made available in standard format by the Program for Climate Model Diagnosis and Intercomparison (PCMDI) at the Lawrence Livermore National Laboratory. Following completion of the computational phase of AMIP in 1993, emphasis will shift to a series of diagnostic subprojects, now being planned, for the detailed examination of model performance and the simulation of specific physical processes and phenomena. AMIP offers an unprecedented opportunity for the comprehensive evaluation and validation of current atmospheric models, and is expected to provide valuable information for model improvement.

24646 (UCRL-ID–113623) **Preliminary validation of the low frequency variability of tropospheric temperature and circulation simulated for the AMIP by the ECMWF model.** Boyle, J.S. Lawrence Livermore National Lab., CA (United States). Apr 1993. 22p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (PCMDI–11). Order Number DE93012382. Source: OSTI; NTIS; INIS; GPO Dep.

The ECMWF global model is used to simulate the climate from 1979 to 1988. This integration is in support of the WGNE Atmospheric Model Intercomparison Project (AMIP). The model uses the observed monthly sea surface temperature for the ten year period during the integration. Anomaly correlation and RMS calculations are carried out between monthly mean observed circulation and the model results, although the use of monthly mean clata restricts the conclusions to the low frequency variability. The variables ancl regions considered are the 500 hPa geopotential and MSU temperatures for the Northern Hemisphere (30N to 70N), the 200 hPa zonal wind and MSU temperatures for the equatorial belt (15S to 15N), and the 1000 hPa zonal wind for the equatorial Pacific (15N to 15S ancl 120E to 100W). The results show: (1) For the midlatitude 500 hPa geopotential there is a signal in the model results for the ENSO events of 1982/1983 and 1986/1987; (2) the model underestimates the midlatitude 500 hPa geopotential interannual variability as measured by the RMS but overestimates the MSU temperature variability in this region; (3) in general, outside of the ENSO periods, there is little correlation between the model and observed data anomalies of midlatitude 500 hPa geopotential; (4) in the tropics the variables evince a stronger correlation with observations, with the 200 hPa winds yielding greater agreement than the MSU temperatures and the 1000 hPa zonal wind showing a significant correlation with observations in the interannual variation; (5) in the tropics the model underestimates the variability of the 200 hPa wind and MSU temperature; (6) the model, although non-interacting with the ocean, produces a credible simulation of the low frequency variability of the equatorial JPacific low level zonal wind.

24647 (UCRL-JC–107143) **A fugacity approach for modeling the transport of airborne organic chemicals in an air/plant/soil system.** Oliver, L.D. (North Carolina Univ., Chapel Hill, NC (United States)); McKone, T.E. Lawrence Livermore National Lab., CA (United States). May 1991. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-910659–36: 84. annual meeting and exhibition of the Air and Waste Management Association (AWMA), Vancouver (Canada), 16-21 Jun 1991). Order Number DE93009283. Source: OSTI; NTIS; INIS; GPO Dep.

An important issue facing both public and private agencies is the identification and quantification of exposures by indirect pathways to toxic chemicals released to the atmosphere. With recent public concerns over pesticides such as malathion and alar in foods, greater attention is being given to the process of chemical uptake by plants. Whether chemicals taken up by plants can accumulate and ultimately enter the human food chain are important questions for determining health risks and safe levels of toxic air-pollutant emissions and pesticide application. A number of plant-toxicokinetic, or "botanicokinetic," models have been developed to give estimates of how chemicals are partitioned and transported within plants. In this paper, we provide a brief review of these models, describing their main features and listing some of their advantages and disadvantages. We then describe and demonstrate a five-compartment air/plant/soil model, which builds on and extends the features included in previous models. We apply this model to the steady-state chemical partitioning of perchloroethylene, hexachlorobenzene, and 2,3,7,8-tetrachlorodibenzo-p-dioxin in grass as test cases. We conclude with a discussion of the advantages and limitations of the model.

24648 (UCRL-JC–108020) **Cloud radiative forcing: A modeling perspective.** Potter, G.L. (Lawrence Livermore National Lab., CA (United States)); Slingo, J.M.; Morcrette, J.J. Lawrence Livermore National Lab., CA (United States). May 1991. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9105202–9: 1. energy research power supercomputer users symposium, Gaithersburg, MD (United States), 21-22 May 1991). Order Number DE93009296. Source: OSTI; NTIS; GPO Dep.

Radiation fields from a perpetual July integration of a high resolution version of the ECMWF operational model are used as surrogate observations of the radiation budget at the top of the atmosphere, to illustrate various difficulties that modelers might face when trying to reconcile cloud radiative forcings derived from satellite observations with those generated by models. Differences between the so-called Methods I and II of Cess and Potter are addressed. Method I is shown to be the least robust of all methods, due to the potential uncertainties related to persistent cloudiness, length of the sampling period, and biases in retrieved clear-sky quantities due to insufficient sampling of the diurnal cycle.

24649 (UCRL-JC–108523) **Towards the development of a global inventory for black carbon emissions.** Penner, J.E. (Lawrence Livermore National Lab., CA (United States)); Eddleman, H.; Novakov, T. Lawrence Livermore National Lab., CA (United States). Oct 1991. 47p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9104368–1-Rev.1: 4. international conference on carbonaceous particles in the atmosphere, Vienna (Austria), 3-5 Apr 1991). Order Number DE93014114. Source: OSTI; NTIS; INIS; GPO Dep.

The authors have developed a global inventory for black carbon (BC) emi measured ambient concentration ratios of black carbon and SO_2 at locations throughout the world. They have extended the data base for black carbon by using "smoke" measurements at a variety of monitoring sites and a calibration factor for black carbon derived herein from ambient "smoke" and BC measurements. They demonstrate that BC to SO_2 ratios are well correlated at

most sites and that distinct ratios of BC to SO_2 apply to source areas from economically distinct regions. However, within any one economic region, the ratio of BC to SO_2 appears to be relatively constant. These facts are used to construct a global inventory of black carbon emissions by using previously published inventories for the emissions of sulfur from fossil fuel use. The derived inventory totals nearly 24 Tg C/yr. This inventory is compared to a crude inventory based on emission factors and published fuel use statistics for wood and bagasse burning, diesel fuel, and domestic and commercial coal use. The combined emissions from wood, diesel, and coal can explain more than 75% of the total global emissions and usually are within a factor of two of the derived regional emissions from the BC/S ratio method. The black carbon inventory, totaling nearly 24 Tg C/yr, is used in the Lawrence Livermore National Laboratory global chemistry/climate model to simulate the world-wide distribution of black carbon. The predicted concentrations are compared with available measurements from throughout the world. This comparison supports the magnitude of the inventory which the authors have derived to within a factor of two, although significant uncertainties with respect to the treatment of scavenging and deposition in the model remain.

24650 (UCRL-JC–108641) **Application of the Ames/ Salmonella assay to routine industrial hygiene work.** Miller, G.C.; Avila, J.; Elliott, J.; Felton, J.; Nielson, J. Lawrence Livermore National Lab., CA (United States). May 1992. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9205215–3: American industrial hygiene conference and exposition, Boston, MA (United States), 30 May - 5 jun 1992). Order Number DE93009526. Source: OSTI; NTIS; GPO Dep.

We have used the Ames/Salmonella assay aggressively for swipe-testing surfaces and for sampling the air people breathe. Our technique for air sampling particulates and subsequently analyzing them using a simple gravimetric assay and the Ames/Salmonella (or other biological) assay is discussed herein. We also discuss some recent applications of the assay to test for mutagenic materials on surfaces and in the air at Lawrence Livermore National Laboratory (LLNL).

24651 (UCRL-JC–108847) **Two dimensional model study of atmospheric transport using carbon-14 and strontium-90 as inert tracers.** Kinnison, D.E. (Lawrence Livermore National Lab., CA (United States)); Wuebbles, D.J.; Johnston, H.S. Lawrence Livermore National Lab., CA (United States). Feb 1992. 44p. Sponsored by USDOE, Washington, DC (United States); National Aeronautics and Space Administration, Washington, DC (United States). DOE Contract W-7405-ENG-48 ;AC03-76SF00098. (CONF-9202172–1: NASA high speed research program models and measurements workshop, Satellite Beach, FL (United States), 2-7 Feb 1992). Order Number DE93012547. Source: OSTI; NTIS; INIS; GPO Dep.

This study tests the transport processes in the LLNL two-dimensional chemical-radiative-transport model using recently reanalyzed carbon-14 and strontium-90 data. These radioactive tracers were produced bythe atmospheric nuclear bomb tests of 1952–58 and 1961–62, and they were measured at a few latitudes up to 35 kilometers over the period 1955–1970. Selected horizontal and vertical eddy diffusion coefficients were varied in the model to test their sensitivity to short and long term transpose of carbon-14. A sharp transition of K_{zz} and K_{yy} through the tropopause, as opposed to a slow transition between the same limiting values, shows a distinct improvement in the calculated carbon-14 distributions, a distinct improvement in the calculated seasonal and latitudinal distribution of ozone columns (relative to TOMS observations), and a very large difference in the calculated ozone reduction by a possible fleet of High Speed Civil Transports. Calculated northern hemisphere carbon-14 is more sensitive to variation of K_{yy} than are global ozone columns. Strontium-90 was used to test the LLNL tropopause height at four different latitudes. Starting with the 1960 background distribution of carbon-14, we calculate the input of carbon-14 as the sum of each nuclear test of the 1961–62 series, using two bomb-cloud rise models. With the Seitz bomb-rise formulation in the LLNL model, we find good agreement between calculated and observedcarbon-14 (with noticeable exceptions at the north polar tropopause and the short-term mid-latitude mid-stratosphere) between 1963 and 1970.

24652 (UCRL-JC–109822) **Coupled ocean-atmosphere GCM simulation of Southern Oscillation phenomena.** Sperber, K.R. (Lawrence Livermore National Lab., CA (United States)); Hameed, S. Lawrence Livermore National Lab., CA (United States). Jul 1992. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9209331–2: 7. Brazilian Meteorological Congress: climate change and the environment, Sao Paulo (Brazil), 28 Sep - 2 oct 1992). Order Number DE93012583. Source: OSTI; NTIS; GPO Dep.

The Oregon State University coupled upper ocean-atmosphere GCM has, been shown to qualitatively simulate the Southern Oscillation. A composite analysis of the warm and cold events simulated in this 23-year integration has been performed. During the low phase of the SO, when warm anomalies occur in the Eastern Pacific the model simulates for the Atlantic region during March–May (1) a deficit of precipitation over the tropical South American continent (2) Caribbean and Gulf of Mexico sea-level pressure and sea-surface temperature are in-phase with the Eastern Pacific anomalies, while those East of the Nordeste region are out-of-phase (3) northeast trade winds are anomalously weak and southwest trade winds are anomalously strong (as inferred from surface current anomalies). During the high phase of the simulated Southern Oscillation conditions in the atmosphere and ocean are essentially the reverse of the low phase. Thus the model produces a response in the South American region during the opposing phases of the Southern Oscillation which is in general agreement with observations.

24653 (UCRL-JC–110400) **The cloud radiative feedback of a midlatitude squall line system and implication for climate study.** Chin, H.N.S. Lawrence Livermore National Lab., CA (United States). 1 May 1992. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-920881–2: 11. international conference on clouds and precipitation, Montreal (Canada), 17-21 Aug 1992). Order Number DE93010511. Source: OSTI; NTIS; INIS; GPO Dep.

The main objectives of this study are (1) to study the impact of longwave and shortwave radiation on the thermodynamic and kinematic structure of a midlatitude squall line; and (2) to explore the influence of specifically including the ice phase in the cloud-radiation feedback mechanism for climate models.

24654 (UCRL-JC–110558) **A self-consistent model of nonlinear parameterization of turbulent diffusion in atmospheric boundary layer.** Gavrilov, V.P. (Institut Eksperimental'noj Meteorologii, Obninsk (Russian Federation)); Klepikova, N.V.; Rodean, H.C.; Gudiksen, P.H. Lawrence Livermore National Lab., CA (United States). Nov 1992. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9209158–12: 10. symposium on turbulence and diffusion, Portland, OR (United States), 29 Sep - 2 oct 1992). Order Number DE93011950. Source: OSTI; NTIS; INIS; GPO Dep.

The paper presents a self-consistent model for pollutant dispersal in the atmosphere in which coefficients of turbulent diffusion are determined through concentration distribution function. Boundary and initial conditions with consideration for real meteorological information and real conditions of dispersal relate fieid measurements to concentration distribution function and correspondingly to diffusion coefficient.

24655 (UCRL-JC–110844) **Integration of measurements with atmospheric dispersion models: Source term estimation for dispersal of ^{239}Pu due to non- nuclear detonation of high explosive.** Edwards, L.L. (Lawrence Livermore National Lab., CA (United States)); Harvey, T.F.; Freis, R.P.; Pitovranov, S.E.; Chernokozhin, E.V. Lawrence Livermore National Lab., CA (United States). Oct 1992. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-921040–1: 3. international workshop on real-time computing of the environmental consequences of an accidental release to atmosphere from a nuclear installation: decision-making support for offsite emergency management installation, Klais (Germany), Order Number DE93012550. Source: OSTI; NTIS; INIS; GPO Dep.

The accuracy associated with assessing the environmental consequences of an accidental release of radioactivity is highly dependent on our knowledge of the source term characteristics and, in the case when the radioactivity is condensed on particles, the particle size distribution, all of which are generally poorly known. This paper reports on the development of a numerical technique that integrates the radiological measurements with atmospheric dispersion modeling. This results in a more accurate particle-size distribution and particle injection height estimation when compared with measurements of high explosive dispersal of ^{239}Pu. The estimation model is based on a non-linear least squares regression scheme coupled with the ARAC three-dimensional atmospheric dispersion models. The viability of the approach is evaluated by estimation of ADPIC model input parameters such as the ADPIC particle size mean aerodynamic diameter, the geometric standard deviation, and largest size. Additionally we estimate an optimal "coupling coefficient" between the particles and an explosive cloud rise model. The experimental data are taken from the Clean Slate 1 field experiment conducted during 1963 at the Tonopah Test Range in Nevada. The regression technique optimizes the agreement between the measured and model predicted concentrations of ^{239}Pu by varying the model input parameters within their respective ranges of uncertainties. The technique generally estimated the measured concentrations within a factor of 1.5, with the worst estimate being within a factor of 5, very good in view of the complexity of the concentration measurements, the uncertainties associated with the meteorological data, and the limitations of the models. The best fit also suggest a smaller mean diameter and a smaller geometric standard deviation on the particle size as well as a slightly weaker particle to cloud coupling than previously reported.

24656 (UCRL-JC–110846) **Comments on possible causes of recent global warming.** Duffy, P.B. Lawrence Livermore National Lab., CA (United States). 24 Sep 1992. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9201148–1: 73. American Meteorological Society (AMS) meeting, Anaheim, CA (United States), 17-22 Jan 1992). Order Number DE93010501. Source: OSTI; NTIS; INIS; GPO Dep.

The researcher shows that recent global temperature changes cannot be due to solar luminosity variations coincident with changes in solar cycle amplitudes, since this would violate causality. In addition, a related suggestion using solar cycle lengths instead of amplitudes appears highly unlikely, since time lags between changes in the cycle lengths and observed temperatures are very different from those calculated with a climate model. Finally, lag correlations between historical land and sea temperates indicate that ocean temperatures follow land temperatures by 15 or 20 yr. This means that the oceans' response time must be at least this long, if these temperature changes are due to some change in external forcing. It also suggests that this is in fact the case, since "natural" climate variations might well entail SSTs changing before LATs, which is not observed.

24657 (UCRL-JC–110922) **The role of human activity and land use change in atmospheric chemistry and air quality.** Penner, J.E. Lawrence Livermore National Lab., CA (United States). Jul 1992. 45p. Sponsored by USDOE, Washington, DC (United States); Environmental Protection Agency, Washington, DC (United States); National Aeronautics and Space Administration, Washington, DC (United States). DOE Contract W-7405-ENG-48. DW89932676-01-0;NAGW-1827. (CONF-9107235–1: SNOWMASS meeting, Denver, CO (United States), 21 Jul - 10 aug 1991). Order Number DE93011871. Source: OSTI; NTIS; INIS; GPO Dep.

In the this paper, I review the importance of a mineral of fossil fuel emissions atmospheric chemistry, air quality, and climate. I then review current estimates of the sources for each specie, deriving the fraction of each source that is due to specific land use practices or land cover categories. Understanding the current trends of those species with known increasing abundances and projecting increases into the future is possible if the estimated sources from human activity and land use change can be projected and if the known atmospheric sinks and the interactions in atmospheric chemistry and climate change are appropriately taken into account. Regional trends in the short-lived species can be projected as well, assuming the estimated sources and sinks are correct. However, significant uncertainties continue to surround the estimated budgets for most of these species. Uncertainties and the estimated ranges in different source strength estimates for each are also discussed.

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Refer also to citation(s) 22767, 22786, 22845, 22913, 22915, 22927, 22930, 22951, 22993, 22998, 23005, 23006, 23015, 23032, 23045, 23056, 23066, 23073, 23075, 23085, 23086, 23091, 23093, 23094, 23095, 23096, 23097, 23098, 23099, 23100, 23101, 23106, 23108, 23127, 23128, 23129, 23132, 23142, 23143, 23350, 23543, 23544, 23632, 23718, 23737, 23744, 23746, 23951, 24058, 24059, 24060, 24070, 24081, 24082, 24250, 24573, 24582, 24593, 24621, 24629, 24630, 24631, 24632, 24640, 24642, 24647, 24811, 24813, 24830, 24831, 24832, 24839, 24866, 24869, 24873, 24883, 24898, 24901, 24902, 24906, 24907, 24909, 24918, 24920, 24931, 25399

24658 (ANL/ER/CP–77595) **Site characterization for the in situ bioremediation of the vadose zone.** Montemagno, C.D. (Argonne National Lab., IL (United States)); Leo, A.; Craig, J. Argonne National Lab., IL (United States). [1993]. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-930585–2: 2. USA/CIS joint conference on environmental hydrology and hydrogeology, Washington, DC (United States), 16-29 May 1993). Order Number DE93010665. Source: OSTI; NTIS; INIS; GPO Dep.

Studies were conducted to determine whether bioremediation can be used to treat a diesel fuel spill in the deep vadose zone (>30 m). After laboratory studies confirmed the ability of the natural population of organisms to degrade the diesel fuel, the technological issue of transporting the required mass of nutrients to the contaminated soils was addressed. Laboratory studies demonstrated that nutrient and oxygen transport can be enhanced by the addition of divalent cations to injected waters. This addition of minerals caused the observed hydraulic conductivity to be maintained at elevated levels that allowed the macronutrient nitrogen, provided as ammonium ion, to be more uniformly distributed to target soil domains.

24659 (ANL/ES/CP–78514) **Separation of heavy metals: Removal from industrial wastewaters and contaminated soil.** Peters, R.W.; Shem, L. Argonne National Lab., IL (United States). Energy Systems Div. [1993]. 62p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-9303107–1: International conference on emerging separation technologies for metals and fuels, Palm Coast, FL (United States), 13-28 Mar 1993). Order Number DE93008657. Source: OSTI; NTIS; GPO Dep.

This paper reviews the applicable separation technologies relating to removal of heavy metals from solution and from soils in order to present the state-of-the-art in the field. Each technology is briefly described and typical operating conditions and technology performance are presented. Technologies described include chemical precipitation (including hydroxide, carbonate, or sulfide reagents), coagulation/flocculation, ion exchange, solvent extraction, extraction with chelating agents, complexation, electrochemical operation, cementation, membrane operations, evaporation, adsorption, solidification/stabilization, and vitrification. Several case histories are described, with a focus on waste reduction techniques and remediation of lead-contaminated soils. The paper concludes with a short discussion of important research needs in the field.

24660 (ANL/ESD/TM–42) **Geophysics: Building E5440 decommissioning, Aberdeen Proving Ground: Interim progress report.** McGinnis, L.D.; Miller, S.F.; Thompson, M.D.; McGinnis, M.G. Argonne National Lab., IL (United States). Energy Systems Div. Nov 1992. 35p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract W-31109-ENG-38. Order Number DE93009086. Source: OSTI; NTIS; GPO Dep.

Building E5440 was one of ten potentially contaminated sites in the Canal Creek and Westwood areas of the Edgewood section of Aberdeen Proving Ground examined by a geophysical team from Argonne National Laboratory in April and May 1992. Noninvasive geophysical surveys, including magnetics, electrical resistivity, and ground-penetrating radar (GPR), were conducted around the

perimeter of the building to guide a sampling program prior to decommissioning and dismantling. The results show several complex geophysical signatures. Isolated, one-point, magnetic anomalies surrounding the building may be associated with construction fill. A 10-ft-wide band of strongly magnetic positive anomalies bordering the north side of the building obliterates small magnetic sources that might otherwise be seen. A prominent magnetic "nose" extending northward from this band toward a standpipe at 100N,63E may be connected to an underground tank. The southeast corner of the site is underlain by a rectangular, magnetized source associated with strong radar images. A magnetic lineament extending south from the anomaly may be caused by a buried pipe; the anomaly itself may be caused by subsurface equipment associated with a manhole or utility access pit. A 2,500-gamma, positive magnetic anomaly centered at 0N,20E, which is also the location of a 12 Ω-m resistivity minimum, may be caused by a buried vault. It appears on radar imaging as a strong reflector.

24661 (ANL/ESD/TM–43) **Geophysics: Building E5476 decommissiong, Aberdeen Proving Ground: Interim progress report.** Miller, S.F.; Thompson, M.D.; McGinnis, M.G.; McGinnis, L.D. Argonne National Lab., IL (United States). Energy Systems Div. Nov 1992. 33p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract W-31109-ENG-38. Order Number DE93011641. Source: OSTI; NTIS; INIS; GPO Dep.

Building E5476 was one of ten potentially contaminated sites in the Canal Creek and Westwood areas of the Edgewood section of Aberdeen Proving Ground examined by a geophysical team from Argonne National Laboratory in April and May of 1992. Noninvasive geophysical surveys, including magnetics, electrical resistivity, and ground-penetrating radar, were conducted around the perimeter of the building to guide a sampling program prior to decommissioning and dismantling. The large number of magnetic sources surrounding the building are believed to be contained in construction fill. The smaller anomalies, for the most part, were not imaged with ground radar or by electrical profiling. Large magnetic anomalies near the southwest comer of the building are due to aboveground standpipes and steel-reinforced concrete. Two high-resistivity areas, one projecting northeast from the building and another south of the original structure, may indicate the presence of organic pore fluids in the subsurface. A conductive lineament protruding from the south wall that is enclosed by the southern, high-resistivity feature is not associated with an equivalent magnetic anomaly. Magnetic and electrical anomalies south of the old landfill boundary are probably not associated with the building. The boundary is marked by a band of magnetic anomalies and a conductive zone trending northwest to southeast. The cause of high resistivities in a semicircular area in the southwest comer, within the landfill area, is unexplained.

24662 (ANL/ESD/TM–44) **Geophysics: Building E5481 decommissioning, Aberdeen Proving Ground: Interim progress report.** Thompson, M.D.; McGinnis, M.G.; McGinnis, L.D.; Miller, S.F. Argonne National Lab., IL (United States). Energy Systems Div. Nov 1992. 33p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract W-31109-ENG-38. Order Number DE93011754. Source: OSTI; NTIS; INIS; GPO Dep.

Building E5481 is one of ten potentially contaminated sites in the Canal Creek and Westwood areas of the Edgewood section of Aberdeen Proving Ground examined by a geophysical team from Argonne National Laboratory in April and May of 1992. Noninvasive geophysical surveys, including magnetics, electrical resistivity, and ground-penetrating radar, were conducted around the perimeter of the building to guide a sampling program prior to decommissioning and dismantling. The building is located on the northern margin of a landfill that was sited in a wetland. The large number of magnetic sources surrounding the building are believed to be contained in construction fill that had been used to raise the grade. The smaller anomalies, for the most part, are not imaged with ground radar or by electrical profiling. A conductive zone trending northwest to southeast across the site is spatially related to an old roadbed. Higher resistivity areas in the northeast and east are probably representive of background values. Three high-amplitude, positive, rectangular magnetic anomalies have unknown sources. The features do not have equivalent electrical signatures, nor are they seen with radar imaging.

24663 (BNL–48451) **A multilayer groundwater sampler for characterizing contaminant plumes: Final report.** Kaplan, E.; Heiser, J. Brookhaven National Lab., Upton, NY (United States). 18 Dec 1992. 20p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. Order Number DE93010935. Source: OSTI; NTIS; INIS; GPO Dep.

This final report describes activities related to the design and initial demonstration of a passive multilayer groundwater sampling system. The apparatus consists of remotely controlled cylinders filled with deionized water which are connected in tandem. Vertical fine structure of contaminants are easily defined. Using the apparatus in several wells may lead to three dimensional depictions of groundwater contamination, thereby providing the information necessary for site characterization and remediation.

24664 (BNL–48908) **Non-invasive multilevel groundwater samplers.** Kaplan, E.; Heiser, J. Brookhaven National Lab., Upton, NY (United States). [1993]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-930769–4: 1993 joint Canadian Society of Civil Engineers-American Society of Civil Engineers (CSCE-ASCE) national conference on environmental engineering, Montreal (Canada), 12-14 Jul 1993). Order Number DE93013398. Source: OSTI; NTIS; INIS; GPO Dep.

Two non-intrusive, passive multilayer groundwater sampling devices are described which collect data simultaneously at small vertical intervals in the same well, without disturbing the geohydrological environment. One system uses membranes, the other uses remotely operated stainless steel cylinders connected in tandem. When used in several wells sufficient information is collected to allow a three dimensional characterization of contaminants and flow in the aquifer. The systems were used during field trials at Savannah River Laboratory in November 1991 and June 1992, and collected water quality and flow data over a 3 meter interval below the water table in each of two wells. Data from 1991 indicate weak vertical profiles in temperature, dissolved oxygen, and pH over the 3 m sampling interval. Other measurements indicated a relatively uniform horizontal specific discharge of about 6 cm/year over the same sampling interval. No statistically significant vertical structure was evident for discharge. This presentation will compare this information with data obtained from field trials in June 1992.

24665 (BNL–70254) **[Experiments on CO_2 enrichment]: Foreign travel trip report, 22–31 October 1992.** Hendrey, G.R. Brookhaven National Lab., Upton, NY (United States). [1992]. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. Order Number DE93008789. Source: OSTI; NTIS (US Sales Only); GPO Dep.

George Hendrey was invited to present seminars in Zurich, Switzerland, to discuss collaboration in research with groups in Switzerland and Germany, to visit laboratories and field research sites in Germany and to participate in the CO_2 Workshop on Design and Execution Experiments on CO_2 Enrichment in Germany. Hendrey will collaborate in setting up Free-Air CO_2 Enrichment field facilities in these two countries. Recommendation were made concerning development of the two FACE field sites. The Workshop, sponsored by IGBP, reviewed advantages and disadvantages of various controlled environments, field chambers and FACE with respect to studies of CO_2 enrichment at the whole ecosystem level. IGBP strongly endorses FACE experiments and will encourage formation of networks of field research efforts.

24666 (CFS/OO–46-13/35-1991E, pp. 21-28) **Acidic atmospheric deposition in eastern North America: Forest resources at risk.** Krause, H.H. (New Brunswick Univ., Fredericton, NB (Canada)). Canadian Forestry Service, Ottawa, ON (Canada). 1991. (CONF-8306311–: Effects of acid rain on forest resources, Sainte-Foy (Canada), 14-17 Jun 1983; MICROLOG–92-03656). In *Effects of acid rain on forest resources: Proceedings.* 667p. Source: PC Forestry Canada, Place Vincent Massey, 351 St. Joseph Blvd., Ottawa, ON, CAN K1A 1G5; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1 PC PRICES UPON REQUEST; MF $10 CAN.

Acidic deposition above natural levels occurs over most of the North American continent east of the 100°W meridian. With an annual growth of ca 475 million m^3 of wood in the United States and 146 million m^3 in Canada, the forests of affected areas contribute significantly to the economies of both countries, but especially in Canada where one in ten jobs is dependent on forestry. In the U.S., ca 10% of the annual forest growth occurs in areas subjected to very heavy acidic deposition, and more than 75% in areas of heavy and moderate deposition. Among the forest ecosystems within the zone of very heavy deposition are sensitive combinations of conifer cover and low buffering capacity soils. In Canada, ca 53% of annual growth is within the zone of light deposition, 43% in zones of moderate and heavy deposition, and only 4% in zones with very heavy deposition. However, unlike the U.S., most of the growth is in regions with coniferous or mixed-growth forests on soils with low buffering capacity and a susceptibility to aluminum toxicity. Besides possible effects on the fibre-producing ability of forests, acidic deposition may indirectly affect terrestrial wildlife and aquatic habitats. Whereas information is still inconclusive with respect to forest productivity and terrestrial wildlife, adverse effects of acidic deposition, at present levels, have been proved for aquatic habitats, and a danger now exists for areas with soils and bedrock of low buffering capacity. 26 refs., 1 fig.

24667 (CFS/OO–46-13/35-1991E, pp. 35-54) **Wet deposition to forests.** Summers, P.W. (Atmospheric Environment Service, Environment Canada, Downsview, ON (Canada)). Canadian Forestry Service, Ottawa, ON (Canada). 1991. (CONF-8306311–: Effects of acid rain on forest resources, Sainte-Foy (Canada), 14-17 Jun 1983; MICROLOG–92-03656). In *Effects of acid rain on forest resources: Proceedings.* 667p. Source: PC Forestry Canada, Place Vincent Massey, 351 St. Joseph Blvd., Ottawa, ON, CAN K1A 1G5; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1 PC PRICES UPON REQUEST; MF $10 CAN.

The phenomena of wet deposition is discussed within the context of the observed global distribution of precipitation chemistry and atmospheric processes. It is related to the natural and anthropogenic sources of predominating chemical species. The development of sampling techniques and observing networks is summarized, and the important considerations of sampler location, time resolution, continuity of records and sources of error are discussed. The main emphasis is on regions of heavy wet deposition, caused by man-made sources in eastern North America and Europe. Both spatial and temporal variations of deposition for the major ions (H^+, SO_4^{2-}, NO_3^-, Ca^{2+}, Mg^{2+}) and heavy metals (Pb, Cd, Cu, V, etc.) are presented. The relationship between deposition patterns, meteorological and climatic factors and forest distribution is compared and contrasted between North America and Europe, in terms of events (short episodes of highly acidic deposition), seasonal variations (with special attention to snowpack accumulation) and longer term trends. Finally, the significance of a recently recognized form of wet deposition by fog and low cloud, especially on elevated forests, is discussed. 22 refs., 8 figs., 3 tabs.

24668 (CFS/OO–46-13/35-1991E, pp. 55-94) **Dry deposition and ambient concentrations.** Neumann, H.H. (Atmospheric Environment Services, Environment Canada, Downsview, ON (Canada)); Hartog, G. den; Bussieres, N. Canadian Forestry Service, Ottawa, ON (Canada). 1991. (CONF-8306311–: Effects of acid rain on forest resources, Sainte-Foy (Canada), 14-17 Jun 1983; MICROLOG–92-03656). In *Effects of acid rain on forest resources: Proceedings.* 667p. Source: PC Forestry Canada, Place Vincent Massey, 351 St. Joseph Blvd., Ottawa, ON, CAN K1A 1G5; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1 PC PRICES UPON REQUEST; MF $10 CAN.

The role of dry deposition in the acid rain problem is examined, particularly with regard to forests of northeastern North America. Available data on ambient concentrations of the relevant atmospheric pollutants are reviewed and related qualitatively to the distribution of emission sources and to the prevailing meteorology. Cyclic seasonal and diurnal variations in concentrations are discussed, as well as the episodic nature of high pollution events. Techniques for estimating dry deposition are briefly described. These include mass balance methods, dryfall collectors and surrogate surfaces, micrometeorological flux measurements, and methods of estimating deposition from ambient concentration. The concept of a deposition velocity is considered in relation to the familiar resistance analogue for atmospheric fluxes within the surface layer. The dependence of deposition velocity on atmospheric parameters and surface characteristics is noted. Finally, some estimates of dry deposition are presented. Results for particular experiments are given, as well as generalized regional patterns derived from the mean concentration fields. Direct measurements of deposition to forests have been relatively rare and so considerable uncertainty remains as to actual deposition rates to forests, especially for particulate deposition. 36 refs., 23 figs., 2 tabs.

24669 (CFS/OO–46-13/35-1991E, pp. 193-206) **The nature, forms and transformations of sulphur in soils.** Stewart, J.W.B. (Saskatchewan Inst. of Pedology, Saskatchewan Univ., Saskatoon, SK (Canada)); Bettany, J.R. Canadian Forestry Service, Ottawa, ON (Canada). 1991. (CONF-8306311–: Effects of acid rain on forest resources, Sainte-Foy (Canada), 14-17 Jun 1983; MICROLOG–92-03656). In *Effects of acid rain on forest resources: Proceedings.* 667p. Source: PC Forestry Canada, Place Vincent Massey, 351 St. Joseph Blvd., Ottawa, ON, CAN K1A 1G5; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1 PC PRICES UPON REQUEST; MF $10 CAN.

The importance of sulfur as an atmospheric pollutant and as an essential nutrient and the increasing occurrence of S deficiency around the world have emphasized the need to obtain an understanding of the nature, form and transformation of S in soils. In particular, although most soil S exists in combination with organic matter, the biological availability of S has only been quantified in a few areas and very rarely in soils receiving significant amounts of exogenous inorganic sulfate. Some of the process studies that have helped elucidate the S cycle dynamics are reviewed, and the possibility and probability of similar processes being active in forest soils are discussed. Information on S transformation processes are reviewed and related to changes that could occur with the addition of extra S in acid rain. Four distinct microbial processes work to transform S in soils: mineralization, immobilization, oxidation, and reduction. Data are presented on carbon, nitrogen and sulfur ratios of world soil types, including effect of parent material, effect of weathering, and effect of climate and cultivation. 52 refs., 1 fig., 1 tab.

24670 (CFS/OO–46-13/35-1991E, pp. 133-152) **Recent changes in the growth of the forest trees in the northeastern United States.** Johnson, A.H. (Pennsylvania Univ., Philadelphia, PA (United States)); Siccama, T.G.; Friedland A.J. Canadian Forestry Service, Ottawa, ON (Canada). 1991. (CONF-8306311–: Effects of acid rain on forest resources, Sainte-Foy (Canada), 14-17 Jun 1983; MICROLOG–92-03656). In *Effects of acid rain on forest resources: Proceedings.* 667p. Source: PC Forestry Canada, Place Vincent Massey, 351 St. Joseph Blvd., Ottawa, ON, CAN K1A 1G5; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1 PC PRICES UPON REQUEST; MF $10 CAN.

The extent and nature of growth changes in pines and spruce were studied to investigate the effects of acid rain on these species. Increment cores from Picea rubens Sarg. in the montane boreal forests of New York, Vermont and New Hampshire show a clear and substantial reduction in growth which began in the early to mid-1960s and preceded a general decline of that species in the high elevation forests of the northeast. In the sandy soils of southern New Jersey, Pinus rigida Mill. and Pinus echinata Mill. show a very similar decline in increment size beginning in the late 1950s. The decreased growth effect is, in each case, widespread, substantial and sustained through to the present, and suggests substantial physiological impairment. The timing of the shift to abnormally slow growth suggests that it is an after-effect of drought stress. Although there are many pathways by which pollutant stress (including acid deposition-induced stress) could contribute to stress in forests, there is currently no evidence which clearly links pollution stress to the observed changes in growth. 29 refs., 10 figs., 1 tab.

24671 (CFS/OO–46-13/35-1991E, pp. 177-186) **Acid rain and the buffer capacity of forest soils.** Hornbeck, J.W. (United States Dept. of Agriculture Forest Services, Durham, NH (United States)); Federer, C.A. Canadian Forestry Service, Ottawa, ON (Canada). 1991. (CONF-8306311–: Effects of acid rain on forest resources, Sainte-Foy (Canada), 14-17 Jun 1983; MICROLOG–92-03656). In *Effects of acid rain on forest resources: Proceedings.* 667p. Source: PC Forestry Canada, Place Vincent Massey, 351 St. Joseph Blvd., Ottawa, ON, CAN K1A 1G5; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1 PC PRICES UPON REQUEST; MF $10 CAN.

Past reviews of the effects of acid rain on soil nutrients suggest five major concerns: increased leaching losses; reduction in cation exchange capacity; accelerated weathering of soil minerals; mobilization of toxic elements; and changes in soil biota. These effects assume that acid precipitation accelerated soil acidification. The capacity of forest soils to buffer H^+ in precipitation was studied by adding H^+ and OH^- to soil samples from forested sites in Maine, New Hampshire and Connecticut. The change in pH for a unit addition of H^+ or OH^- is nearly independent of pH for these soils. Buffer capacity ranged from 5 to 15 mmol(H^+)/kg/pH in the mineral soils, and from 20 to 100 mmol(H^+)/kg/pH in forest floors. The buffer capacity was closely related organic content. In a worst case situation, in which mitigating factors are neglected, the buffer capacity values indicate that a change in pH of one unit in the forest floor would require an addition of only 2-10 kmol(H^+)/ha while a change of one unit in the mineral soil would require 30-50 kmol(H^+)/ha. These data suggest that forest soils may not be as effective as a buffer as has previously been thought. 20 refs., 1 fig., 3 tabs.

24672 (CFS/OO–46-13/35-1991E, pp. 187-192) **Solubility and mobility of aluminum by acidification of soils.** Singh, S.S. (Chemistry and Biology Research Inst., Agriculture Canada, Ottawa, ON (Canada)). Canadian Forestry Service, Ottawa, ON (Canada). 1991. (CONF-8306311–: Effects of acid rain on forest resources, Sainte-Foy (Canada), 14-17 Jun 1983; MICROLOG–92-03656). In *Effects of acid rain on forest resources: Proceedings.* 667p. Source: PC Forestry Canada, Place Vincent Massey, 351 St. Joseph Blvd., Ottawa, ON, CAN K1A 1G5; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1 PC PRICES UPON REQUEST; MF $10 CAN.

Soils are complex dynamic systems which occur as products of processes of soil formation and weathering. Acid precipitation is one of many components which have been added to soils by intensified economic activity. Aluminum is not a major component of acidic precipitations, however the concentration of Al in soil solution is pH dependent. Aluminum exists in soil in a number of solid and solution forms. The soluble forms of aluminum are controlled by the pH and the anion association. Aluminum hydrolyzes readily, and anions associated with Al have an effect on hydrolysis. The formation of soluble complexes of Al, such as $AlSO_4^+$, influences many reactions. A comparison of soil chemistry of Al in the presence of Cl and SO_4^{2-} ions shows significant differences in the distribution of aluminum species. In the presence of SO_4^{2-} ions, a substantial amount of aluminum exists as monovalent $AlSO_4^+$, which is not as effective as trivalent aluminum in competing with basic cations for occupying exchange sites. Thus, in SO_4^{2-} systems, a substantial amount of Al is present in a form which can easily move in the soil profile or can leach out of the soil profile to the aquatic environment. The ratio of $AlSO_4^+$ to Al^{3+} is controlled by the activity of SO_4^{2-} ions. A 10-fold change in SO_4^{2-} results in a 10-fold change in this ratio. On leaching of $AlSO_4^{2+}$ ions from soil systems to aquatic systems, dilution effects would effectively revert the $AlSO_4^+$ ions to Al^{3+} ions.

24673 (CFS/OO–46-13/35-1991E, pp. 209-229) **Acid rain effects on nitrogen availability from litter and organic matter decomposition.** Mahendrappa, M.K. (Canadian Forestry Service, Fredericton, NB (Canada)). Canadian Forestry Service, Ottawa, ON (Canada). 1991. (CONF-8306311–: Effects of acid rain on forest resources, Sainte-Foy (Canada), 14-17 Jun 1983; MICROLOG–92-03656). In *Effects of acid rain on forest resources: Proceedings.* 667p. Source: PC Forestry Canada, Place Vincent Massey, 351 St. Joseph Blvd., Ottawa, ON, CAN K1A 1G5; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1 PC PRICES UPON REQUEST; MF $10 CAN.

The combined effects of various nitrogen transformation processes in soil in relation to the nature of the plants or trees have to be taken into consideration in evaluating the availability of nitrogen in any ecosystem. The same edaphic factors that affect plant growth also influence nitrogen transformation processes and ecological stability. Litter decomposition and organic matter turnover are also integral parts of the cycle that limits nitrogen availability to trees. Normal growth and development of forest stands, therefore, depend on the continuity of all the inter-related processes that influence nitrogen availability. Acidification of forest ecosystems from external sources can affect chemical and biological nitrogen transformation processes within trees, in the soil, and also in the atmosphere. Data on nitrogen availability in acidified forest ecosystems indicate both favourable and deleterious effects of acidification. 92 refs., 5 figs., 1 tab.

24674 (CFS/OO–46-13/35-1991E, pp. 232-248) **Evolution of forest soils of Quebec under acid pH conditions.** Kimpe, C.R. de (Agriculture Canada, Ste-Foy, PQ (Canada)). Canadian Forestry Service, Ottawa, ON (Canada). 1991. (CONF-8306311–: Effects of acid rain on forest resources, Sainte-Foy (Canada), 14-17 Jun 1983; MICROLOG–92-03656). In *Effects of acid rain on forest resources: Proceedings.* 667p. Source: PC Forestry Canada, Place Vincent Massey, 351 St. Joseph Blvd., Ottawa, ON, CAN K1A 1G5; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1 PC PRICES UPON REQUEST; MF $10 CAN.

The large variety of Podzolic soils in Quebec, as illustrated by some typical profiles, depends on the nature of the parent material. The principal mechanisms responsible for the translocation of Al^{3+} cations released from primary minerals by protons are reviewed. The first mechanism involves the formation of organometallic complexes, but it cannot satisfactorily explain the formation of all types of Podzolic soils. The second mechanism considers that mineral aluminosilicate complexes, such as protoimogolite, are the main factors able to transport Al^{3+} down the profile. Dissolution of primary minerals and their transformation into secondary minerals, as well as the further evolution of secondary minerals, are largely dependent on the leaching of M^+ and M^{2-} cations and on the final Al_2O_3/SiO_2 molar ratio. Podzilic soils in Quebec still contain a large supply of cations, yet their ability to neutralize H^+ ions is determined by the availability of these cations and by the residence time of the percolating water. In the soils developed on till, saturated hydraulic conductivity is higher in the solum than in the parent material, and the solum is more depleted of cations. Some relationships between soil properties and H^+ neutralization are discussed. 36 refs., 5 figs., 3 tabs.

24675 (CFS/OO–46-13/35-1991E, pp. 251-265) **Acid deposition and element cycling in eastern North American forests.** Foster, N.W. (Canadian Forestry Service, Sault Ste-Marie, ON (Canada)); Nicolson, J.A.; Morrison, I.K. Canadian Forestry Service, Ottawa, ON (Canada). 1991. (CONF-8306311–: Effects of acid rain on forest resources, Sainte-Foy (Canada), 14-17 Jun 1983; MICROLOG–92-03656). In *Effects of acid rain on forest resources: Proceedings.* 667p. Source: PC Forestry Canada, Place Vincent Massey, 351 St. Joseph Blvd., Ottawa, ON, CAN K1A 1G5; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1 PC PRICES UPON REQUEST; MF $10 CAN.

Current knowledge of the relationship between atmospheric deposition of acids and acid-forming substances on the one hand and element fluxes on the other in major eastern North American forest types is reviewed. A mature tolerant hardwood forest on a well-drained acid till soil at Turkey Lakes Watershed in northern Ontario serves as a point of reference. Nitrogen and sulfur fluxes between element pools within the ecosystem are emphasized because of the association of N and S forms with acid pollution. Nitrogen turnover (ca 45 kg/ha/y) in the reference forest ecosystem is much greater than atmospheric N input (ca 12 kg/ha/y) and streamflow N output (ca 7 kg/ha/y). Thus, a tight cycle of N is maintained in this undisturbed old-growth hardwood forest. Input/output of sulfate-S

(SO_4-S) in the watershed is roughly in balance. Sulfate concentrations are equal to 70% of the total base cation concentrations, on an equivalent-weight basis, in soil water below the rooting zone of the reference forest. At current levels, atmospheric inputs of SO_4-S contribute significantly to losses of base cations (K, Ca, Mg, Na) from the rooting zone of many eastern ecosystems. A reduction in the quantity of SO_4-S entering eastern forest soils would likely reduce cation losses from these ecosystems. 40 refs., 2 figs., 6 tabs.

24676 (CFS/OO–46-13/35-1991E, pp. 383-390) **Effects of acid deposition on soil and litter properties: Lysimeter and field studies.** Brown, K.A. (Central Electricity Research Lab., Leatherhead, Surrey (UK)); Skeffington, R.A. Canadian Forestry Service, Ottawa, ON (Canada). 1991. (CONF-8306311–: Effects of acid rain on forest resources, Sainte-Foy (Canada), 14-17 Jun 1983; MICROLOG–92-03656). In *Effects of acid rain on forest resources: Proceedings.* 667p. Source: PC Forestry Canada, Place Vincent Massey, 351 St. Joseph Blvd., Ottawa, ON, CAN K1A 1G5; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1 PC PRICES UPON REQUEST; MF $10 CAN.

A major effect of acidic deposition on litter and soil is claimed to be accelerated leaching of basic cations (Ca^{2+}, Mg^{2+}, K^+) from cation-exchange sites and their replacement by H^+. The mobilization of Al also increases, as in mineral soils of pH 3.5-5.5 solution and precipitation of Al are the main buffering mechanisms. The results of a long-term study in which soil was watered at a reasonably realistic pH are reported and compared with those found in a similar forest soil in the field, in order to highlight similarities and differences compared to the laboratory study. Pairs of lysimeters containing undisturbed soil cores received either distilled water or sulfuric acid (pH 3) at ca 1,500 mm/y for almost 5 years. Significant decreases in pH, base saturation, and basic cations were observed, with significant increases in extractable sulfate and aluminum. The depth distributions and concentrations of pH, extractable ions, Ca, Mg and Mn cations, extractable aluminum, and various biochemical properties are presented. The effects of the presence of trees on extractable Ca, Mg, Mn and Al are displayed. 7 refs., 2 figs., 6 tabs.

24677 (CFS/OO–46-13/35-1991E, pp. 391-399) **Impacts of acid rain on two forested watersheds in Haute Ardenne, Belgium.** Buldgen, P. (Liege Univ. (Belgium)); Remacle, J. Canadian Forestry Service, Ottawa, ON (Canada). 1991. (CONF-8306311–: Effects of acid rain on forest resources, Sainte-Foy (Canada), 14-17 Jun 1983; MICROLOG–92-03656). In *Effects of acid rain on forest resources: Proceedings.* 667p. Source: PC Forestry Canada, Place Vincent Massey, 351 St. Joseph Blvd., Ottawa, ON, CAN K1A 1G5; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1 PC PRICES UPON REQUEST; MF $10 CAN.

Two forested watersheds have been studied for four years in eastern Belgium. One of the two watersheds is entirely covered by softwoods, whereas the other one is partly covered by softwoods and partly by hardwoods. The aim of the study is to evaluate the impact of vegetal cover and atmospheric pollution on nutrient turnover and aquifer and streamwater chemistry. Open-site precipitation over the country is acidic. The acidity increases significantly at the level of throughfall rain, through the interception of acidic pollutants by the vegetal cover. This interception is more pronounced for softwoods than for hardwoods, and the acidification by organic matter mineralization seems to depend on both the nature and thickness of the organic layers. The streamwaters flowing out from the two watersheds have percolated through the mineral soil, and in this way, their acidity is to some extent neutralized. Consequently, the watersheds accumulate annually 60-70% of the inputs of acidity from pollutants and organic matter mineralization. 14 refs., 4 figs., 1 tab.

24678 (CFS/OO–46-13/35-1991E, pp. 323-328) **Resource sensitivity assessment.** McFee, W.W. (Purdue Univ., West Lafayette, IN (United States)). Canadian Forestry Service, Ottawa, ON (Canada). 1991. (CONF-8306311–: Effects of acid rain on forest resources, Sainte-Foy (Canada), 14-17 Jun 1983; MICROLOG–92-03656). In *Effects of acid rain on forest resources: Proceedings.* 667p. Source: PC Forestry Canada, Place Vincent Massey, 351 St. Joseph Blvd., Ottawa, ON, CAN K1A 1G5; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1 PC PRICES UPON REQUEST; MF $10 CAN.

The assessment of resource sensitivity to acidic precipitation is discussed. All the assessments generalize spatially, but have varying scales and levels. Sensitivity generally refers to propensity to acidification, and does not infer more general extrapolations. Historical attempts at resource sensitivity assessment are described. The errors that are easily made in producing sensitivity maps are discussed, and shown to result generally from unwarranted assumptions and neglection of other factors. For example, mapping of agricultural soils at risk to acidification must take into account application of lime fertilizer or other treatments that vastly overshadow any effects of acidic deposition. Mapping should be limited to simple characteristics or at least very simple sets of characteristics.

24679 (CFS/OO–46-13/35-1991E, pp. 303-320) **Acid stress on forest habitats: Implications for terrestrial wildlife.** Schreiber, R.K. (U.S. Fish and Wildlife Service, Kearneysville, WV (United States)); Fischer, K.L. Canadian Forestry Service, Ottawa, ON (Canada). 1991. (CONF-8306311–: Effects of acid rain on forest resources, Sainte-Foy (Canada), 14-17 Jun 1983; MICROLOG–92-03656). In *Effects of acid rain on forest resources: Proceedings.* 667p. Source: PC Forestry Canada, Place Vincent Massey, 351 St. Joseph Blvd., Ottawa, ON, CAN K1A 1G5; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1 PC PRICES UPON REQUEST; MF $10 CAN.

Forests and their stratified structure provide a diversity of habitats for a variety of wildlife species. Although the influence of acidic deposition on forests is incompletely known, preliminary research indicates that impacts may occur. Indirect impacts on wildlife are possible from modification of habitat and change in trophic relationships. Detection of changes distinguishable from normal spatio-temporal variations in wildlife populations is difficult. An overview is provided of the current information on the impacts of acidic deposition and its precursors on forest resources and the possible implications for terrestrial wildlife. Issues discussed include physiological and ecological responses of wildlife to air emissions, susceptibility of breeding habitat to pH depression for amphibians, effects on amphibians of pH depression, food resources of snake species that may be reduced due to acidic precipitation, habitat and diet of turtle species with range into acid-impacted areas of Canada, mammalian species with diet organisms susceptible to acid precipitation, and avian species most likely to be imapcted by reduced food resources due to acid rain. 79 refs., 1 fig., 10 tabs.

24680 (CFS/OO–46-13/35-1991E, pp. 329-335) **Acidic deposition and air pollution: Implications for forest management.** Voigt, G.K. (Oregon State Univ., Corvallis, OR (United States)); Boyle, J.R. Canadian Forestry Service, Ottawa, ON (Canada). 1991. (CONF-8306311–: Effects of acid rain on forest resources, Sainte-Foy (Canada), 14-17 Jun 1983; MICROLOG–92-03656). In *Effects of acid rain on forest resources: Proceedings.* 667p. Source: PC Forestry Canada, Place Vincent Massey, 351 St. Joseph Blvd., Ottawa, ON, CAN K1A 1G5; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1 PC PRICES UPON REQUEST; MF $10 CAN.

An overview is presented of the implications of acid rain and air pollution with respect to forestry. Possible interactions among air pollutants, ecosystem productivity and forest management that have implications for forest management in North America are discussed, emphasizing acidic deposition resulting from sulfur contamination of the atmosphere. Intensive harvesting techniques can accelerate nutrient removal from forest sites, and in general the degree of forest management must be considered so that potentially adverse effects of air pollution may be identified. Productive capacity and the eventual sustainability of harvests is most significantly determined by the harvesting interval. Clear-cut harvesting of any kind removes the forest canopy, which is the first layer receiving deposition. If understory canopy is removed and the floor is disturbed, the mineral soil will be exposed for some time to the full impacts of acidic precipitation. Whole tree harvesting leaves significantly less residue to contribute to site resilience. Harvesting and

post-harvest treatments influence patterns of snow deposition, and can interact with acid flush into soils or drainage systems. Species conversion can have a variety of implications related to the chemistry of deposition materials reaching the forest floor and mineral soil. 20 refs.

24681 (CFS/OO–46-13/35-1991E, pp. 336-345) **Multiple use implications of acid rain and forest resources.** McClenahan, J.R. (Ohio State Univ., Wooster, OH (United States)). Canadian Forestry Service, Ottawa, ON (Canada). 1991. (CONF-8306311–: Effects of acid rain on forest resources, Sainte-Foy (Canada), 14-17 Jun 1983; MICROLOG–92-03656). In *Effects of acid rain on forest resources: Proceedings.* 667p. Source: PC Forestry Canada, Place Vincent Massey, 351 St. Joseph Blvd., Ottawa, ON, CAN K1A 1G5; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1 PC PRICES UPON REQUEST; MF $10 CAN.

The stability of particular forest communities depends not only on pollutant dose, but on the nature of the ecosystem as well. Acid deposition and other pollutants may be slightly stimulatory or produce no perceptible effects where the dose is small or the ecosystem is complex and well buffered. Where the dose is large or the ecosystem is simpler or poorly buffered, a significantly altered state may ultimately result. Measures of broader aspects of ecosystem functioning can give clues to eventual community changes, but may not reflect changes in special amenities such as the loss or reduction of rare species. It is proposed that the risk of altering natural terrestrial ecosystems through acid deposition or other pollutants, with attendant loss of amenities, will generally increase with the number of following conditions which obtain: relict communities, major ecotones, or other community types growing near the limits of their natural range; communities containing a high proportion of specialists (usually late successional); communities having potentially unstable mineral cycles; and communities subject to major additional disturbances by abiotic or biotic agents such as fire, harvesting, or insect and disease epidemics. 32 refs., 2 figs., 1 tab.

24682 (CFS/OO–46-13/35-1991E, pp. 358-378) **Lake Laflamme catchement basin: Excursion guide.** Robitaille, G. (Centre de Foresterie des Laurentides, Ste-Foy, PQ (Canada)). Canadian Forestry Service, Ottawa, ON (Canada). 1991. (CONF-8306311–: Effects of acid rain on forest resources, Sainte-Foy (Canada), 14-17 Jun 1983; MICROLOG–92-03656). In *Effects of acid rain on forest resources: Proceedings.* 667p. Source: PC Forestry Canada, Place Vincent Massey, 351 St. Joseph Blvd., Ottawa, ON, CAN K1A 1G5; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1 PC PRICES UPON REQUEST; MF $10 CAN.

The Lake Laflamme catchment is situated 80 km north of Quebec City. The 825 m rise across the area causes an environmental gradient strong enough to delimit several vegetation zones. The climate of the area is characterized by low temperatures and abundant precipitation. Sampling is carried out at the catchment to obtain data on: precipitation and air quality, the deposition and concentration of several ions (H, Ca, Mg, Na, K, NH_4, SO_4, NO_3, PO_4 and Cl) to the terrestrial and aquatic systems, and the seasonal and yearly variations in deposition and concentration; changes in quantity and chemical composition of precipitation as it passes through the vegetation cover; the chemistry of soil percholates; quantity and quality of snowmelt; snow chemistry in the open and under forest cover; lake chemistry; chemistry of lake water inputs and outputs; ion flux through the catchment; and the potential effects of acidification on the accumulation of bioelements by the vegetation. Details are presented of the studies that are being carried out in the catchment, data collected, and agencies participating in the project. 6 figs., 8 tabs.

24683 (CFS/OO–46-13/35-1991E, pp. 495-500) **Changes in acid flux through forest canopies.** Miller, H.G. (Macaulay Inst. for Soil Research, Aberdeen (United Kingdom)); Miller, J.D.; Cooper, J.M.; Flower, C.A. Canadian Forestry Service, Ottawa, ON (Canada). 1991. (CONF-8306311–: Effects of acid rain on forest resources, Sainte-Foy (Canada), 14-17 Jun 1983; MICROLOG–92-03656). In *Effects of acid rain on forest resources: Proceedings.* 667p. Source: PC Forestry Canada, Place Vincent Massey, 351 St. Joseph Blvd., Ottawa, ON, CAN K1A 1G5; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1 PC PRICES UPON REQUEST; MF $10 CAN.

It has long been established that there is considerable alteration in rainwater chemistry during passage through a forest canopy. There is debate over whether the source of sodium, chloride and sulfate enriching rainwater passing over trees is leaching from the foliar surfaces of interception deposition. A study was carried out of rainwater acidity beneath a range of vegetation types. Data are presented on variations in pH and mean H^+ concentration in water collected from various points on its passage through a Scottish forest ecosystem over a period of 5 years. Considerable annual variation was found, and it was clear that the pattern of annual oscillation in throughfall and stemflow pH develops and intensifies with decreasing average pH of incident rainfall. No effect of soil or physical climate was identified. All species except old Pinus sylvestris reduced acidity in throughfall. It is suggested that crowns may have a role damping the impact of sudden excursions of acidity. 8 refs., 3 figs.

24684 (CFS/OO–46-13/35-1991E, pp. 441-463) **Chemical characteristics of sequential acid-rain episodes, canopy throughfall and steamwater quality in a yellow birch stand, Laurentides Park, Canada.** Jones, H.G. (Quebec Univ., Ste-Foy, PQ (Canada)); Auclair, J.C.; Cluis, D.; Ouellet, M. Canadian Forestry Service, Ottawa, ON (Canada). 1991. (CONF-8306311–: Effects of acid rain on forest resources, Sainte-Foy (Canada), 14-17 Jun 1983; MICROLOG–92-03656). In *Effects of acid rain on forest resources: Proceedings.* 667p. Source: PC Forestry Canada, Place Vincent Massey, 351 St. Joseph Blvd., Ottawa, ON, CAN K1A 1G5; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1 PC PRICES UPON REQUEST; MF $10 CAN.

Sequential sampling of incident precipitation, throughfall and streamwaters during individual storm events in a mature yellow birch watershed showed that the effect of tree cover on the precipitation caused the resultant throughfall to reflect chemical characteristics related to dry deposition washoff and leaching of the vegetative canopy. Total canopy net exchange (deposition ratio) of soluble components ($<0.45\mu m$) with the incident precipitation increased in the order of $Pb<H^+<Na^+<SO_4^{2-}<Fe<NO_3^-<Ca^{2+}<Mg^{2+}<Mn<K^+$. The rate of dry deposition washoff was best estimated from Al and Fe analysis of sequential samples, which in turn permitted the determination of net leaching rates of elements where total deposition ratios were high (Ca, Mg, Mn and K). Marked differences between throughfall chemical characteristics of different events (eg. pH) were not reflected by the major headwater streams (pH 4.4-4.8) draining the watershed. Al, present in only low concentrations in both precipitation and throughfall, is found to be constantly present at high concentration in the streamwaters. 19 refs., 15 figs., 1 tab.

24685 (CFS/OO–46-13/35-1991E, pp. 485-494) **Direct and indirect acid-induced changes in foliar chemical content.** Malanchuk, J.L. (State Univ. of New York, Plattsburg, NY (United States)); Rhea, J.R.; Engelbride, E.; Smyth, B.; Miner, W.H. Canadian Forestry Service, Ottawa, ON (Canada). 1991. (CONF-8306311–: Effects of acid rain on forest resources, Sainte-Foy (Canada), 14-17 Jun 1983; MICROLOG–92-03656). In *Effects of acid rain on forest resources: Proceedings.* 667p. Source: PC Forestry Canada, Place Vincent Massey, 351 St. Joseph Blvd., Ottawa, ON, CAN K1A 1G5; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1 PC PRICES UPON REQUEST; MF $10 CAN.

Acid deposition may involve changes in chemical content of plant foliage which might disturb forest element cycling. Although acid rain is known to accelerate the leaching of plant substances from foliar surfaces, it is not known whether such changes occur directly at foliar surfaces or indirectly through soil acidification. Pinto beans (Phaseolus vulgaris L.) were grown under greenhouse conditions for 70 days, using soil collected from Whiteface Mountain in the Adirondacks region of New York State. Plants received 50 ml of distilled water three times weekly for 63 days. Thirty days after planting, plants received the same volume of synthetic acid rain

adjusted to pH 2.5, 4.0, and 5.5 depending on treatment. Treatment I received rain by means of an air atomizer with rain percolating into the soil, Treatment II received rain by uniform application to the soil surface without wetting the foliage, while Treatment III received rain like Treatment I but rain was prevented from entering the soil, and 50 ml of distilled water was applied to prevent soil dessication. Leaves were separated after the plants were harvested and analyzed for Al, Ca, Mg, K, Mn, and total N. Results suggest there are differences in elemental concentrations of plant foliage among teatments. Differences varied with the pH of the simulated rain and the elements studied. No general trends for all elements were obvious. 3 refs., 7 figs.

24686 (CFS/OO–46-13/35-1991E, pp. 419-427) **Ion transfer through a tolerant hardwood canopy, Turkey Lakes Watershed, Ontario.** Foster, N.W. (Canadian Forestry Service, Sault Ste-Marie, ON (Canada)); Nicolson, J.A. Canadian Forestry Service, Ottawa, ON (Canada). 1991. (CONF-8306311–: Effects of acid rain on forest resources, Sainte-Foy (Canada), 14-17 Jun 1983; MICROLOG–92-03656). In *Effects of acid rain on forest resources: Proceedings.* 667p. Source: PC Forestry Canada, Place Vincent Massey, 351 St. Joseph Blvd., Ottawa, ON, CAN K1A 1G5; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1 PC PRICES UPON REQUEST; MF $10 CAN.

Hydrogen, K, Ca, NO_3-N and SO_4-S were measured, during 1981, outside and within an old-growth sugar maple-yellow birch forest growing on an acid till soil at Turkey Lakes Watershed, Ontario. Mean concentration and contents of elements in precipitation, throughfall and stemflow were compared on an annual, growing season and dormant season basis. Throughfall solutions were similar to precipitation in ionic composition, with the exception of K concentration, during the dormant period, and were less acid and richer in bases and SO_4-S during the growing season. Stemflow solutions were highly enriched in Ca, K and SO_4-S and depleted in H and NO_3-N, during both periods. Throughfall was the major process of element transfer to soil: stemflow accounted for only 1-10% of the total annual deposition of each element to the soil. The role of H in promoting base leaching from the forest canopy is discussed in relation to other eastern North American tolerant hardwood forests, which are more heavily impacted with acid precipitation. 30 refs., 3 tabs.

24687 (CFS/OO–46-13/35-1991E, pp. 400-408) **Soil and bedrock characteristics of eastern Canada: Acidic deposition and implications for forest productivity.** Cowell, D.W. (Environment Canada, Burlington, ON (Canada)). Canadian Forestry Service, Ottawa, ON (Canada). 1991. (CONF-8306311–: Effects of acid rain on forest resources, Sainte-Foy (Canada), 14-17 Jun 1983; MICROLOG–92-03656). In *Effects of acid rain on forest resources: Proceedings.* 667p. Source: PC Forestry Canada, Place Vincent Massey, 351 St. Joseph Blvd., Ottawa, ON, CAN K1A 1G5; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1 PC PRICES UPON REQUEST; MF $10 CAN.

Available soil and bedrock data for eastern Canada have been combined into eight map units representing five dominant terrain types. Three of these five categories describe dominant soil texture: sand, loam and clay. Organic soils and barren terrain (≥75% bedrock outcropping) are the remaining two categories. Given the absence of proven cause and effect relationships between acid deposition and forests, it is considered preferable to map terrain characteristics rather than forest-productivity sensitivity. Hypothetical sensitivity interpretations are provided for sensitivity to base-cation loss, soil acidification and aluminum solubilization. These sensitivities are based on predicted or expected soil properties for each map unit. It is suggested that those areas mapped as sand overlying any rock type or loam overlying granite (primarily acid Podzols and Brunisols) are the most sensitive with respect to forest productivity. This interpretation assumes that Al^{3+} solubilization and the loss of even small amounts of nutrient cations are most significant factors potentially impacting forest systems. The map base is however, sufficiently flexible to allow other interpretations. 20 refs., 1 fig., 2 tabs.

24688 (CFS/OO–46-13/35-1991E, pp. 409-417) **An experiment to assess the sensitivity of soil to acidification.** Dimma, D.E. (Ontario Ministry of Environment, Toronto, ON (Canada)); Griffith, M.A.; Linzon, S.N. Canadian Forestry Service, Ottawa, ON (Canada). 1991. (CONF-8306311–: Effects of acid rain on forest resources, Sainte-Foy (Canada), 14-17 Jun 1983; MICROLOG–92-03656). In *Effects of acid rain on forest resources: Proceedings.* 667p. Source: PC Forestry Canada, Place Vincent Massey, 351 St. Joseph Blvd., Ottawa, ON, CAN K1A 1G5; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1 PC PRICES UPON REQUEST; MF $10 CAN.

In an experiment, surface soil horizons from a variety of soil types across Ontario were treated with acidic reagents (nitric, sulfuric, nitric-sulfuric and simulated rain). Soil pH was then measured to determine the relative sensitivity of the soils to acidification. The surface samples collected from Podzolic soil profiles had pH below 4.5. They were the least sensitive to acidification, possibly due to their abundance of organic matter. Surface soils with pH above 4.5, when combined with acidic reagents, showed greater decreases in soil pH than Podzolic soils under the same conditions. This indicated a lower buffering capacity in the less acidic soils. Within-sample decreases in soil pH were largely a function of the type of acid added to the soil. Generally, nitric acid was the most effective in lowering soil pH while sulfuric acid was the least effective. 7 refs., 2 figs., 3 tabs.

24689 (CFS/OO–46-13/35-1991E, pp. 474-484) **Influence of acidification on metal uptake by plants.** Lobersli, E. (Trondheim Univ., Dragvoll (Norway)); Steinnes, E. Canadian Forestry Service, Ottawa, ON (Canada). 1991. (CONF-8306311–: Effects of acid rain on forest resources, Sainte-Foy (Canada), 14-17 Jun 1983; MICROLOG–92-03656). In *Effects of acid rain on forest resources: Proceedings.* 667p. Source: PC Forestry Canada, Place Vincent Massey, 351 St. Joseph Blvd., Ottawa, ON, CAN K1A 1G5; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1 PC PRICES UPON REQUEST; MF $10 CAN.

Increased mobility of metals as a result of soil acidification may affect their availability to plants. A study was carried out to determine the possible influences of soil acidification on plant uptake of aluminum, iron and manganese, major elements in silicate rocks. A study of birch in a local acidification gradient indicated a strong influence on metal uptake. For example, the manganese content of Betula pubescens increases and the iron content decreases with increasing distance from the source. In a comparison of coniferous forest ecosystems in southern and central Norway, metal uptake in plants growing in soils with different acid-base conditions was studied. Corresponding ecosystems in the two regions are compared in search of possible effects of the great difference in exposure to acid precipitation that exists between different parts of the country. Certain spruce ecosystems in southern Norway appear to show higher contents of aluminum in soil extracts and in the wood anenome, Anemone nemorosa, than corresponding ecosystems in central Norway. 2 refs., 6 figs., 2 tabs.

24690 (CFS/OO–46-13/35-1991E, pp. 532-538) **The interaction between mobile anions and aluminum in a shallow podzol.** Nilsson, S.I. (Swedish Univ. of Agricultural Sciences, Uppsala (Sweden)). Canadian Forestry Service, Ottawa, ON (Canada). 1991. (CONF-8306311–: Effects of acid rain on forest resources, Sainte-Foy (Canada), 14-17 Jun 1983; MICROLOG–92-03656). In *Effects of acid rain on forest resources: Proceedings.* 667p. Source: PC Forestry Canada, Place Vincent Massey, 351 St. Joseph Blvd., Ottawa, ON, CAN K1A 1G5; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1 PC PRICES UPON REQUEST; MF $10 CAN.

The chemical properties of aluminum play a significant role in the acidification of soils and freshwaters. Several compounds and dissolved complexes act as proton buffers. High aluminum concentration can also cause toxicity effects in streams and lakes, which have a high level of other dissolved electrolytes. Data are presented which illustrate the importance of different anions for the aluminum concentration found in the soil solution of a shallow podzol under mixed coniferous forest on the Swedish west coast. The

site is situated within the L. Gardsjon catchment and has been intensively studied since 1979. It was found that a high nitrification potential in an acid soil has implications for the aluminum concentration in the soil solution. 25 refs., 2 figs., 1 tab.

24691 (CFS/OO–46-13/35-1991E, pp. 584-596) **Foliar buffering capacity in boreal species: Sources of variability and potential use of buffering capacity for indexing species sensitivity to acidic pollutants.** Sidhu, S.S. (Canadian Forestry Service, St. John's, NF (Canada)). Canadian Forestry Service, Ottawa, ON (Canada). 1991. (CONF-8306311–: Effects of acid rain on forest resources, Sainte-Foy (Canada), 14-17 Jun 1983; MICROLOG–92-03656). In *Effects of acid rain on forest resources: Proceedings.* 667p. Source: PC Forestry Canada, Place Vincent Massey, 351 St. Joseph Blvd., Ottawa, ON, CAN K1A 1G5; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1 PC PRICES UPON REQUEST; MF $10 CAN.

Foliar buffering capacity (BC) of several boreal species of tree lifeforms (lichens to trees) was determined at nine different times from June 1980 to September 1981. BC varied very little diurnally and with north, south, east and west aspects. In the 1981 foliage of all species, BC was at a maximum during the first two weeks of July and decreased gradually towards fall. In evergreen species, BC of 1980 foliage was half that of the 1981 foliage in the spring and 20-30% lower than 1981 foliage at the end of the growing season. The BC of individual trees of the same species varied significantly and the differences were consistent. In spite of the diurnal, seasonal and intra-specific variations, average BC differences among species were real and genetically controlled. Nutrient analysis of the foliage samples collected in spring and fall of 1980 are also presented. Relative BC of species is compared to reported species sensitivity to sulfur dioxide or acid rain. The potential use of BC for indexing species sensitivity to acid rain appears promising, however requires testing under simulated as well as natural conditions. 12 refs., 3 figs., 5 tabs.

24692 (CFS/OO–46-13/35-1991E, pp. 501-506) **Significance of nutrient cycling processes in forest ecosystems in altering acid rain effects.** Mahendrappa, M.K. (Canadian Forestry Service, Fredericton, NB (Canada)). Canadian Forestry Service, Ottawa, ON (Canada). 1991. (CONF-8306311–: Effects of acid rain on forest resources, Sainte-Foy (Canada), 14-17 Jun 1983; MICROLOG–92-03656). In *Effects of acid rain on forest resources: Proceedings.* 667p. Source: PC Forestry Canada, Place Vincent Massey, 351 St. Joseph Blvd., Ottawa, ON, CAN K1A 1G5; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1 PC PRICES UPON REQUEST; MF $10 CAN.

The effects of acid rain on terrestrial ecosystems can often be explained in terms of its influence on various nutrient cycling processes. The ecosystems, being dynamic and resilient, can be expected to have mechanisms to buffer acid rain effects. Such resiliency can vary among different ecosystems depending on their components and their ability to counteract or withstand perturbations. Some of the discernible influences of tree species in altering acid rain effects are discussed. Nutrient cycling studies were started during the early 1970s in six softwood and three hardwood stands located at the Acadia Forest Experimental Station in central New Brunswick. From the data obtained, there are at least four distinct species-dependent processes that appear to alter acid rain effects. These processes include: partitioning of rain water; exchange reactions of nutrients at the plant (leaf and bark) surfaces; building up of organic matter (humus) horizons under the stands; and exchange reactions within the organic horizons. The relative significance of each of these processes in altering acid rain effects in different stands is discussed. 5 refs., 1 fig., 5 tabs.

24693 (CFS/OO–46-13/35-1991E, pp. 548-561) **Acid rain, drought, and red spruce growth responses.** Puckett, L.J. (United States Geological Survey, Reston, VA (United States)). Canadian Forestry Service, Ottawa, ON (Canada). 1991. (CONF-8306311–: Effects of acid rain on forest resources, Sainte-Foy (Canada), 14-17 Jun 1983; MICROLOG–92-03656). In *Effects of acid rain on forest resources: Proceedings.* 667p. Source: PC Forestry Canada, Place Vincent Massey, 351 St. Joseph Blvd., Ottawa, ON, CAN K1A 1G5; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1 PC PRICES UPON REQUEST; MF $10 CAN.

Incremental growth cores were collected from red spruce (Picea rubens Sarg.) trees growing on bedrock and on glacial till at the Hubbard Brook experimental forest, West Thornton, New Hampshire. Results of regression analyses of tree growth indices against orthogonally transformed temperature and precipitation data for two time periods, 1932-1956 and 1956-1980 indicate that the relationship of tree growth to climate has been altered. For trees growing over bedrock the variance explained by climate decreased from 56.9 to 23.5% and the variance due to prior growth increased from 2.3 to 66.4%. Statistical t-tests and F-tests of climate data for the two periods indicate that climate has been essentially the same from 1932 through to 1980. The Palmer Drought Index indicates that droughts have occurred in 60% of the last 50 years with a peak magnitude in the mid-1960s. It has been shown that the hydrogen ion component of acid rain is neutralized through dissolution of reactive alumina in glacial till soils. The toxic Al^{3+} thus generated may damage the root systems of the red spruce. However, as a result of the formation of organometallic complexes in the humus layer of the glacial till soils, roots in the humus layer may not be damaged, thereby effectively restricting root systems of trees growing on glacial till to the humus layer. The root systems of trees growing in thick humus over bedrock would not be damaged to the same extent. During prolonged dry periods trees with restricted root systems would be more severely stressed than trees physiologically acclimated to growing in humus over bedrock. 32 refs., 4 figs., 3 tabs.

24694 (CFS/OO–46-13/35-1991E, pp. 562-568) **Alteration of precipitation chemistry by deciduous and coniferous canopies.** Puckett, L.J. (United States Geological Survey, Reston, VA (United States)); Kennedy, M.M. Canadian Forestry Service, Ottawa, ON (Canada). 1991. (CONF-8306311–: Effects of acid rain on forest resources, Sainte-Foy (Canada), 14-17 Jun 1983; MICROLOG–92-03656). In *Effects of acid rain on forest resources: Proceedings.* 667p. Source: PC Forestry Canada, Place Vincent Massey, 351 St. Joseph Blvd., Ottawa, ON, CAN K1A 1G5; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1 PC PRICES UPON REQUEST; MF $10 CAN.

Throughfall was collected in adjacent coniferous and deciduous stands in the Mill Run watershed in northwestern Virginia. Nine sample sets during a period of 13 weeks between July and November 1982 had mean pH values of 4.40, 4.37, and 4.11 for precipitation, deciduous througfall and coniferous throughfall, respectively. The pH of coniferous throughfall differed significantly ($P<0.05$) from that of precipitation and deciduous throughfall. Beneath both canopy types there was a net gain of H^+, Ca^{2+}, Mg^{2+}, K^+, NO_3 and SO_{42-} and a net loss of NH_4^+. Calcium ions and Mg^{2+} were preferentially leached from conifers and K^+ from hardwoods. It is assumed that cations are leached from these plant tissues at accelerated rates by H^+ exchange reactions, and by diffusion and mass flow. 19 refs., 1 fig., 2 tabs.

24695 (CFS/OO–46-13/35-1991E, pp. 517-525) **Effects of artificial acid rain on percolate chemistry of two jack pine forest soils.** Morrison, I.K. (Canadian Forestry Service, Sault Ste-Marie, ON (Canada)). Canadian Forestry Service, Ottawa, ON (Canada). 1991. (CONF-8306311–: Effects of acid rain on forest resources, Sainte-Foy (Canada), 14-17 Jun 1983; MICROLOG–92-03656). In *Effects of acid rain on forest resources: Proceedings.* 667p. Source: PC Forestry Canada, Place Vincent Massey, 351 St. Joseph Blvd., Ottawa, ON, CAN K1A 1G5; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1 PC PRICES UPON REQUEST; MF $10 CAN.

Two soils, both acid glacio-fluvial sands from beneath semimature jack pine (Pinus banksiana Lamb.) forest in northern Ontario were reconstructed in 1 m deep column-lysimeters in a greenhouse compartment. Over a 5 1/2 year period, the soils, a humo-ferric Podzol from Wells township and a Dystric Brunisol from Dupuis township were subjected on a weekly basis to artificial acid rain consisting of H_2SO_4 at pH 2, 3, and 4, together with a distilled water control (pH 5.7). The application rate of the simulated rain was equivalent to 1000 mm/y. Percolates were recovered and volumes were recorded weekly; every fourth week, pH, conductivity and

concentrations of SO_4^{2-}, K^+, Na^+, Ca^{2+}, Mg^{2+} and several trace metals including Al, Mn and Zn were determined. The focus was on soil reactions as interpreted from percolate chemistry. Particular attention was paid to the course of events over time. The results of the experiment suggested a stage-by-stage process of element loss: first, both soils, but particularly the humo-ferric Podzol, exhibited considerable initial resistance to base leaching, with SO_4^{2-} movement hampered by strong SO_4^{2-} retention; second, when SO_4^{2-} adsorption capacity reached the saturation point, bases moved freely with excess SO_4^{2-} ions; third, as exchangeable cations were depleted, H^+ ions increasingly dominated the charge composition; concurrently, with the pH of the percolating solutions declining from 6.5 to less than 4.0 during this stage in soils treated with acid rain having a pH of 2, there was substantial mobilization of trace metals, particularly Al. 22 refs., 3 figs., 1 tab.

24696 (CFS/OO–46-13/35-1991E, pp. 508-516) **Biomass and macroelements in a tolerant hardwood stand, Turkey Lakes Watershed, Ontario.** Morrison, I.K. (Canadian Forestry Service, Sault Ste-Marie, ON (Canada)). Canadian Forestry Service, Ottawa, ON (Canada). 1991. (CONF-8306311–: Effects of acid rain on forest resources, Sainte-Foy (Canada), 14-17 Jun 1983; MICROLOG–92-03656). In *Effects of acid rain on forest resources: Proceedings.* 667p. Source: PC Forestry Canada, Place Vincent Massey, 351 St. Joseph Blvd., Ottawa, ON, CAN K1A 1G5; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1 PC PRICES UPON REQUEST; MF $10 CAN.

Data are presented on the distribution of standing-crop biomass and of N, P, K, Ca, Mg and S by components (foliage, live branches, dead branches, stem bark, stem wood, stumps and roots) in an old-growth sugar maple-yellow birch stand on a shallow, Precambria-derived acid till soil in Turkey Lakes Watershed, Ontario. The most abundant element in the standing crop was Ca followed by N>K>Mg>S>P. Presented also, for the same site, are estimates made over a 3 year period of annual total litterfall and the annual cycle of elements from vegetation to soil by this route. The most abundant element in the annual litterfall was N, followed by Ca>K>Mg>S>P. In addition, data are presented on distributions of total organic matter and of elements in the forest floor of the study stand. The order of elements in the forest floor was N>Ca>S>K>Mg>P. The role of litterfall in replenishing bases removed from the soil through plant uptake and leaching is discussed. 24 refs., 1 fig., 3 tabs.

24697 (CFS/OO–46-13/35-1991E, pp. 571-577) **Chemical effects of simulated acid rain on two forest soils.** Rutherford, G.K. (Queen's Univ., Kingston, ON (Canada)); Mortensen, S.F.; Hern, J.A.; Loon, G.W. van. Canadian Forestry Service, Ottawa, ON (Canada). 1991. (CONF-8306311–: Effects of acid rain on forest resources, Sainte-Foy (Canada), 14-17 Jun 1983; MICROLOG–92-03656). In *Effects of acid rain on forest resources: Proceedings.* 667p. Source: PC Forestry Canada, Place Vincent Massey, 351 St. Joseph Blvd., Ottawa, ON, CAN K1A 1G5; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1 PC PRICES UPON REQUEST; MF $10 CAN.

Parallel laboratory and field experiments were conducted in which soil columns from the Turkey Lake and Montmorency Forest watersheds were watered with simulated rainfall of pH 5.7, 3.5 and 2.0. The watering solutions had been acidified with dilute H_2SO_4/HNO_3 in a ratio of 2.5:1. Soil pore water samples were analyzed for H^+, NH_4^+, Na, K, Ca, Mg, Fe, Mn, Al, SO_4^{2-}, NO_3^- and Cl. Following treatment, a number of soil properties were studied. Accelerated leaching of cations, especially Ca and Al (and NH_4^+ in the laboratory columns) was observed as a result of pH 2 acid treatment; SO_4^{2-} was the principle anion carrier. Deposition of SO_4^{2-} was most prominant in the litter-humus layer and in the region of the Bfh horizon. The highly acidic treatment led to significant replacement of metallic cations by hydrogen on the exchange complex, and there is tentative evidence of accelerated podzolization under these conditions. There were smaller changes in cation content of pore water when watering was done with pH 3.5 compared with pH 5.7 rainfall. 4 refs., 5 tabs.

24698 (CFS/OO–46-13/35-1991E, pp. 526-531) **Ion movement in terrestrial basins in the Turkey Lakes Forest Watershed.** Nicolson, J.A. (Canadian Forestry Service, Sault Ste-Marie, ON (Canada)). Canadian Forestry Service, Ottawa, ON (Canada). 1991. (CONF-8306311–: Effects of acid rain on forest resources, Sainte-Foy (Canada), 14-17 Jun 1983; MICROLOG–92-03656). In *Effects of acid rain on forest resources: Proceedings.* 667p. Source: PC Forestry Canada, Place Vincent Massey, 351 St. Joseph Blvd., Ottawa, ON, CAN K1A 1G5; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1 PC PRICES UPON REQUEST; MF $10 CAN.

Twenty small feeder streams with basins of 4-65 ha are being monitored so that their contribution to the main aquatic system can be estimated and gross chemical changes in the terrestrial ecosystem measured. Unit flow rates in five streams monitored ranged from 5.0 to 6.3 m^3/ha/y with snowmelt providing 38-55% of total annual discharge. Streams draining headwater areas with shallow soil are generally lower in pH, alkalinity, and conductivity than streams in the main watershed in areas with deeper soil at lower elevations. Feeders with large groundwater flow, as evidenced by annual temperature profiles, have the highest alkalinities and higher values for some major ions, primarily because percolating water has more contact time with soils and unweathered parent material. Nitrogen input exceeded outputs in four of five watersheds, so N appears to be accumulating in this ecosystem. Output of major cations (Ca^{2+}, Mg^{2+}, K^+ and Na^+) exceeded input by precipitation in all cases except for K^+ in one watershed. Sulfate-sulfur input and output are nearly in balance in four basins. Bicarbonate, as reflected in alkalinity values, was more important in balancing cation losses in areas of lower elevation and deeper soil, whereas sulfate appears to play this role in shallow soil headwater basins. Chemical variability between streams in a watershed can be large and some areas are sensitive to increased hydrogen ion load. 4 refs., 1 fig., 3 tabs.

24699 (CFS/OO–46-13/35-1991E, pp. 578-582) **Cuticular and dendrochronological features as indicators of environmental pollution.** Sharma, G.K. (Tennessee Univ., Martin, TN (United States)). Canadian Forestry Service, Ottawa, ON (Canada). 1991. (CONF-8306311–: Effects of acid rain on forest resources, Sainte-Foy (Canada), 14-17 Jun 1983; MICROLOG–92-03656). In *Effects of acid rain on forest resources: Proceedings.* 667p. Source: PC Forestry Canada, Place Vincent Massey, 351 St. Joseph Blvd., Ottawa, ON, CAN K1A 1G5; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1 PC PRICES UPON REQUEST; MF $10 CAN.

Several plant populations of red oak (Quercus rubra) and sweetgum (Liquidambar styraciflua) growing in habitats characterized by varied levels of environmental pollution were studied for dendrochronological and cuticular patterns. Growth rings, ring and porous wood, and related features were analyzed with a dendrochronograph. Cuticular patterns such as stomatal frequency, stomatal size, and trichome frequency and type were studied in relation to environmental pollution in various habitats. Most plant populations under investigation were in the industrial areas of Nashville, Tennessee, known for their high levels of environmental pollution including sulfur dioxide. Statistical analysis of the data revealed the significance of plant features as indicators of environmental pollution in the area. Growth rings were extremely narrow in highly polluted areas, whereas the plant population exhibited fully developed annual increments in relatively low levels of environmental pollution. Trichome frequency increased with pollution, whereas stomatal frequency decreased with polluted habitats. Stomatal size was not signficantly affected by different levels of pollution. Certain morphological features showed adaptations to varied amounts of environmental pollution. 14 refs., 1 tab.

24700 (CFS/OO–46-13/35-1991E, pp. 602-611) **Heavy metal contamination of terrestrial ecosystems from long-range atmospheric transport.** Solberg, W. (Trondheim Univ. (Norway)); Steinnes, E. Canadian Forestry Service, Ottawa, ON (Canada). 1991. (CONF-8306311–: Effects of acid rain on forest resources, Sainte-Foy (Canada), 14-17 Jun 1983; MICROLOG–92-03656). In *Effects of acid rain on forest resources: Proceedings.* 667p. Source: PC Forestry Canada, Place Vincent Massey, 351 St. Joseph Blvd., Ottawa, ON, CAN K1A 1G5; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1 PC PRICES UPON REQUEST; MF $10 CAN.

The deposition of some toxic elements has been shown to be substantially higher in the southernmost part of Norway than in areas further north, mainly because of transport of polluted air from other parts of Europe. Natural surface soils have been shown to exhibit a very similar geographical pattern with respect to the same group of elements. For example, the surface soil Pb content is 10 times higher in the far south than in parts of central and northern Norway, which are not appreciably affected by long-range atmospheric transport of pollutants. Studies of the vertical distribution of metals in soil profiles from different parts of the country lend further support to the idea of atmospheric deposition being the main source of excess Pb and Cd in the surface soils of southern Norway. A comparison of coniferous forest ecosystems in central and southern Norway with respect to heavy metal content of common species of higher plants shows a similar trend as for soils. Concerning Pb and Cd, plants from localities in southernmost Norway show substantially higher contents than those from equivalent localities in central Norway, the difference in many cases amounting to a factor of 5 or more. The essential elements Cu and Zn do not exhibit a similar trend. 9 refs., 6 figs.

24701 (CFS/OO–46-13/35-1991E, pp. 613-620) **Microbial incorporation of sulfate into organic matter in forest soils.** Swank, W.T. (United States Dept. of Agriculture, Forest Service, Otto, NC (United States)); Fitzgerald, J.W.; Ash, J.T. Canadian Forestry Service, Ottawa, ON (Canada). 1991. (CONF-8306311–: Effects of acid rain on forest resources, Sainte-Foy (Canada), 14-17 Jun 1983; MICROLOG–92-03656). In *Effects of acid rain on forest resources: Proceedings.* 667p. Source: PC Forestry Canada, Place Vincent Massey, 351 St. Joseph Blvd., Ottawa, ON, CAN K1A 1G5; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1 PC PRICES UPON REQUEST; MF $10 CAN.

The metabolism of inorganic sulfate into organic matter by microbial populations can be an important process in the sulfur cycle of forest ecosystems. A study was conducted on Coweeta Watershed 18, a 12.5 ha north-facing catchment which has been a primary site of long-term nutrient cycling research. Soils were incubated and then washed and extracted to recover sulfate. The influence of varying amounts of $^{35}SO_4^{2-}$ added to soil samples on the recovery of various fractions is illustrated. Additional recovery data for salt-extractable and non-salt extractable fractions for forest floor and horizons are presented. Potential annual incorporation in forest floor and soil horizons in a mixed deciduous forest in the southern Appalachian mountains was estimated to be 30 kg/ha. The process is partially responsible for apparent sulfur accumulation indicated by ecosystem budgets and affects sulfate mobility, cation leaching, and hence the interpretation of atmospheric sulfuric acid effects on forest ecosystems. 16 refs., 3 figs., 3 tabs.

24702 (CFS/OO–46-13/35-1991E, pp. 621-628) **Stratifying wet atmospheric deposition samples.** Verry, E.S. (United States Dept. of Agriculture, Forest Service, Grand Rapids, MN (United States)); Harris, A.R. Canadian Forestry Service, Ottawa, ON (Canada). 1991. (CONF-8306311–: Effects of acid rain on forest resources, Sainte-Foy (Canada), 14-17 Jun 1983; MICROLOG–92-03656). In *Effects of acid rain on forest resources: Proceedings.* 667p. Source: PC Forestry Canada, Place Vincent Massey, 351 St. Joseph Blvd., Ottawa, ON, CAN K1A 1G5; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1 PC PRICES UPON REQUEST; MF $10 CAN.

Changes in forest trees, soils and lakes related to atmospheric deposition cannot be ascribed to the total deposition of sulfate or nitrate and their assumed correlation with hydrogen. Of the total deposition, one portion is associated with high concentrations of salt derived from soil dust or sea spray, and another is associated with normally low salt concentrations and high hydrogen concentrations. A procedure to stratfiy samples into one stratum dominated by basic cations (Ca, Mg, K, Na, and NH_4) and one stratum dominated by hydrogen is presented. Correlation between hydrogen and nitrate, sulfate, or the sum is dramatically improved in the H-dominated stratum. It is suggested that data in this stratum relate better to emissions and measures of resource degradation. 4 refs., 3 figs., 2 tabs.

24703 (CONF-920791–, pp. 7, Paper 8) **In situ fiberoptic monitors for site characterization.** Haas, J.W. III (Oak Ridge National Lab., TN (US)); Matthews, T.G.; Gammage, R.B. USDOE Assistant Secretary for Environmental Restoration and Waste Management, Washington, DC (United States). Jul 1992. From Information exchange meeting on characterization sensors and monitoring technologies; Dallas, TX (United States); 15-16 Jul 1992. In *Proceedings of the information exchange meeting on characterization, sensors, and monitoring technologies.* 261p. Order Number DE93005318. Source: OSTI; NTIS.

Contamination of soil and groundwater in the U.S. and many other parts of the world is an enormous problem. Environmental cleanup is requiring considerable expenditures of time and money, especially for initial site characterization and long-term monitoring. Methods that are faster and more efficient are needed to help contain escalating costs. One way to do this is to employ inexpensive instruments to make field measurements of contaminants. Devices that can make direct (in situ) measurements rapidly (in a few minutes or less) are best and can potentially provide more reliable information than conventional sampling and analysis. For example, conventional approaches rely on samples obtained from a few subsurface locations to represent a much larger sampling volume; multipoint sampling is too expensive and time consuming. Also, samples can change composition during transport, holding, and preparation for analysis, ultimately producing unreliable results. Rapid, in situ detection overcomes these limitations by readily providing multipoint measurements without the need to collect and handle samples. In situ monitoring is also safer - site workers and analysts need not be exposed to contaminated samples. The objective is to develop and deploy cost effective, in situ monitoring devices at DOE sites. Specifically, the authors have been designing and fabricating portable spectrometers equipped with fiberoptic probes for in situ detection of contaminants in groundwater and soil gas. In some cases, selective probes are being developed to detect particular classes of contaminants that are difficult to determine by direct spectroscopic analysis (e.g., chlorinated hydrocarbon solvents). This paper will describe progress in the development and demonstration of two of these fiberoptic instruments, a derivative ultraviolet absorbance spectrometer (DUVAS) and a spectroelectrochemical sensor.

24704 (CONF-920791–, pp. 7, Paper 12) **A multisorbent arrayed sampler for in-situ collection of vadose zone volatile organic compounds.** Jenkins, R.A. (Oak Ridge National Lab., TN (US)); Higgins, C.E.; Gayle, T.M.; Allin, G.W.; Smith, R.R. USDOE Assistant Secretary for Environmental Restoration and Waste Management, Washington, DC (United States). Jul 1992. From Information exchange meeting on characterization sensors and monitoring technologies; Dallas, TX (United States); 15-16 Jul 1992. In *Proceedings of the information exchange meeting on characterization, sensors, and monitoring technologies.* 261p. Order Number DE93005318. Source: OSTI; NTIS.

This presentation describes briefly the development and initial field demonstrations of multisorbent sampler for in-situ collection of volatile species at depths up to 125 in the vadose zone. The sampler consists of an array of six traps each packed with sequential beds of sorbent materials. One end of each trap can be opened to a screened space. The sampler can be lowered into a 4 diameter screened borehole and controlled from the surface. Air samples of nearly any volume and/or time duration can be passed through the traps and the volatile organics retained. The arrayed sampler is then returned to the surface and the traps analyzed. Inflatable packers can be used to isolate the geologic zone being sampled if appropriate. The system has been successfully deployed and demonstrated at the Savannah River Integrated Demonstration Project site in January and March, 1992. Numerous vadose zone samples were collected. Data acquired during the sampling yielded a wide range of apparent soil gas concentrations. Although recommendations for system modifications are made, it is clear that in its current configuration, the system can provide time and spatially resolved chemical information concerning the impact, effectiveness, and zone of influence of candidate remediation technologies, for both target (trichloroethylene) and non-target species in the vadose zone.

24705 (CONF-920791–, pp. 7, Paper 13) **Passive multi-layer groundwater samplers.** Kaplan, E. (Brookhaven National Lab., Upton, NY (US)). USDOE Assistant Secretary for Environmental Restoration and Waste Management, Washington, DC (United States). Jul 1992. From Information exchange meeting on characterization sensors and monitoring technologies; Dallas, TX (United States); 15-16 Jul 1992. In *Proceedings of the information exchange meeting on characterization, sensors, and monitoring technologies.* 261p. Order Number DE93005318. Source: OSTI; NTIS.

Non-invasive, multi-level groundwater sampling systems were designed and are being tested at the VOC Nonarid ID at the Savannah River Laboratory (SRL). They provide information on the concentration of contaminants and horizontal flows in an aquifer, simultaneously at several depths in the same well. This information is necessary to properly design remediation but cannot be obtained using existing technologies instead, clusters of wells are usually installed at great expense, and samples are pumped from each well. Unfortunately pumping has been shown to perturb the aquifer being investigated and samples which are collected. In addition, samples collected using standard methods represent conditions over some large zone in the vicinity of the pump, not necessarily those conditions where contaminants actually exist. Two different system were constructed using commercially available components. These apparatus were first tested in the laboratory and field at Brookhaven National Laboratory, after which an initial field trial was conducted at SRL in November 1991. Measurements were made on samples collected over a 300 cm interval below the water table. Preliminary results indicate weak vertical profiles of several inorganic species, and a uniform horizontal specific discharge of approximately 6 cm/day. A second field trial in the same wells is scheduled for June 1992. During FY93 these systems will be used in several existing wells at the SRL ID site. Resulting data will be combined to provide a three dimensional perspective of aquifer chemistry and flow, and will be used in numerical models of contaminated fate and transport. Cost/benefit analyses will be made to indicate the substantial savings which are expected.

24706 (CONF-920791–, pp. 6, Paper 18) **Cross borehole electromagnetic imaging of chemical and mixed waste landfills.** Borns, D.J. (Sandia National Labs., Albuquerque, NM (US)). USDOE Assistant Secretary for Environmental Restoration and Waste Management, Washington, DC (United States). Jul 1992. From Information exchange meeting on characterization sensors and monitoring technologies; Dallas, TX (United States); 15-16 Jul 1992. In *Proceedings of the information exchange meeting on characterization, sensors, and monitoring technologies.* 261p. Order Number DE93005318. Source: OSTI; NTIS.

The Mixed Waste landfill Integrated Demonstration (MWLID) seeks to test noninvasive characterization methods at several locations. One location is the Chemical Waste Landfill (CWL) at Sandia National Laboratories, which consists of unlined disposal pits or trenches (10 ft. wide by 1 0 ft. long by 8 feet deep). Another possible location is the Mixed Waste Landfill (MWL), also at Sandia National Laboratories, which consists of unlined pits (10 ft. by 10 ft. by 25 ft. deep) and trenches (40 ft. wide by 100 ft. long by 30 ft. deep). The soils of the landfills are alluvial, predominantly sand with small quantities of sifts and clays. At these mixed-waste sites, the authors are demonstrating two high frequency EM methods (a continuous waveform (CW) and a pulsed radar system) for site characterization. The CW system is a frequency domain system that is driven by a sinusoidal transmitter waveform. Signal amplitude and phase relative to the transmitter waveform are measured. The pulsed system is a time domain system, in which the transmitter is pulsed and the resulting signal is picked up at the receiving antennae. The measurement consists of transient time and signal strength. The authors will interpret the data using existing interpretation methods and new forward and inverse modeling schemes that are under development within the Geophysics Department at Sandia National Laboratories. Both the CW and pulsed methods are sensitive to variations in either electrical conductivity or dielectric constant in the soils or host rock at a waste site. These earth properties are some of the most responsive geophysical indicators of metallic, acidic and water-based subsurface contaminants. Electrical properties are not best suited to map organic contaminants, such as TCE, except in special cases where the organic contaminant reacts with the clays in the subsurface thus changing the conductivity of the clay-bearing unit.

24707 (CONF-920791–, pp. 6, Paper 19) **Nonintrusive and intrusive sensing of environmentally important objects.** Duray, J.R. (Chem-Nuclear Geotech, Inc., Grand Junction, CO (US)); Snyder, D.D.; Mac Lean, H.D.; Hasbrouck, J.C.; George, D.C. USDOE Assistant Secretary for Environmental Restoration and Waste Management, Washington, DC (United States). Jul 1992. From Information exchange meeting on characterization sensors and monitoring technologies; Dallas, TX (United States); 15-16 Jul 1992. In *Proceedings of the information exchange meeting on characterization, sensors, and monitoring technologies.* 261p. Order Number DE93005318. Source: OSTI; NTIS.

Integration of various nonintrusive and intrusive geophysics techniques provides an optimum selection of corroborating, complementary data that can be used effectively to characterize buried contamination. This paper briefly presents the substance of live technical tasks that focus on rapid, economical geophysical techniques. Two integrated demonstrations provide the funding support for these tasks: the Buried-Waste Integrated Demonstration (BWID) and the Mixed-Waste Landfill Integrated Demonstration (MWLID). The tensor magnetic gradiometer task is intended to identify magnetic objects and their coordinates. The broadband electromagnetic and other surface techniques task is intended to nonintrusively locate buried wastes, characterize the contents of buried wastes, and detect contaminant plumes. The prompt fission logging task is intended to perform in situ assays for fissile elements and heavy metals.

24708 (CONF-920791–, pp. 4, Paper 20) **Ground-penetrating radar (GPR) for remotely controlled site characterization.** Davis, K.C. (Pacific Northwest Lab., Richland, WA (US)); Sandness, G.A. USDOE Assistant Secretary for Environmental Restoration and Waste Management, Washington, DC (United States). Jul 1992. From Information exchange meeting on characterization sensors and monitoring technologies; Dallas, TX (United States); 15-16 Jul 1992. In *Proceedings of the information exchange meeting on characterization, sensors, and monitoring technologies.* 261p. Order Number DE93005318. Source: OSTI; NTIS.

Ground-penetrating radar (GPR) is a non-intrusive sensing method that provides a means of investigating the subsurface of the earth to depths of roughly 0-10 m in typical ground materials. The GPR method is one of the primary tools being used to characterize and remediate hazardous waste burial sites, including those at U.S. Department of Energy (DOE) facilities. Many such sites have already been studied and some have received remedial actions. However, the vast majority still require field investigations, including surface-based geophysical surveys. Survey objectives include: (1) location and characterization of buried waste deposits, (2) detection and mapping of contaminant plumes in groundwater and (3), definition of subsurface geologic and hydrologic features. In comparison with other available sensing methods, GPR offers significant benefits in terms of survey efficiency, spatial resolution, imaging, data interpretability, and versatility. In recent years it has become a primary tool for characterizing hazardous waste burial sites. Unfortunately, the success of the GPR method is strongly site dependent because of the complexity and diversity of the earth materials. The combinations of soil, rock, water, ice, air, plant material, and man-made materials tend to be strong absorbers and reflectors of radar signals; hence, the ground tends to be an unfavorable signal propagation medium. At any given site, the quality of the data is determined largely by the rate of signal absorption in the ground and by clutter (signals reflected from features other than those of interest). The depth at which a given target can be detected and the spatial resolution with which detected objects and structures can be defined are usually determined by the signal-to-clufter ratio in the GPR.

24709 (CONF-920791–, pp. 6, Paper 21) **In situ mapping of radionuclides in subsurface and surface soils.** Schilk, A.J. (Battelle, Pacific Northwest Lab., Richland, WA (US)); Perkins, R.W.; Robertson, D.E.; Brodzinski, R.L. USDOE Assistant Secretary for Environmental Restoration and Waste Management, Washington, DC (United States). Jul 1992. From Information exchange meeting

on characterization sensors and monitoring technologies; Dallas, TX (United States); 15-16 Jul 1992. In *Proceedings of the information exchange meeting on characterization, sensors, and monitoring technologies.* 261p. Order Number DE93005318. Source: OSTI; NTIS.

The operation of nuclear facilities at several Department of Energy (DOE) sites has resulted in local contamination of some surface and subsurface soils which commonly occurs within waste burial sites, cribs, and pond bottom sediments, as well as areas surrounding waste tanks, uranium ore and tailings areas, scrap, and slag heaps. The three-dimensional distribution of contaminants within underlying soils must be adequately determined before effective remediation protocols can be established. A specific site of concern is the DOE's Fernald Environmental Management Project (FEMP) facility near Cincinnati, Ohio. The overall objective of this project is to adapt, develop, and demonstrate technologies for the measurement of uranium in surface and subsurface soils at the Integrated Demonstration (ID) Site which lies within the FEMP boundaries, and to evaluate these for other types of radionuclide contamination. To accomplish the subsurface characterization phase of this program, the authors are employing downwell gamma-ray spectrometry sensors for measuring natural and "added" uranium contents as a function of depth and compass direction within existing and yet to be made boreholes. The surface characterization phase of this program will employ two separation detection systems, one of which will measure the gamma-ray emitting radionuctides over relatively large surface areas. This particular technique is expected to be particularly useful in the preliminary screening of the site for identifying areas of elevated uranium concentrations and generating an initial map of surface activity contours. An additional system is being designed to observe the beta radiation emanating from smaller surface areas for the purpose of obtaining a near-instantaneous indication of uranium surface contamination, before and after actual clean-up efforts.

24710 (CONF-920791–, pp. 4, Paper 22) **In situ permeable flow sensor: A device for measuring groundwater flow velocity.** Ballard, S. (Sandia National Labs., Albuquerque, NM (US)). USDOE Assistant Secretary for Environmental Restoration and Waste Management, Washington, DC (United States). Jul 1992. From Information exchange meeting on characterization sensors and monitoring technologies; Dallas, TX (United States); 15-16 Jul 1992. In *Proceedings of the information exchange meeting on characterization, sensors, and monitoring technologies.* 261p. Order Number DE93005318. Source: OSTI; NTIS.

A new instrument which uses a thermal perturbation technique to directly measure the 3-dimensional groundwater flow velocity vector in permeable geologic formations is being developed at Sandia National Laboratories. Since groundwater flow is perhaps the most important mechanism for dispersal of many types of toxic waste once they have been released into the subsurface, accurate information about the groundwater flow field is critical to the characterization of waste sites, monitoring of waste remediation activities and monitoring the post-closure performance of remediated waste sites. The basic operating principle is to bury a thin cylindrical heater in the ground at the point where the groundwater flow velocity is to be measured. If the heat flux out of the cylinder is uniform over the surface of the cylinder then the temperature distribution on the surface of the cylinder will vary as a function of the direction and magnitude of the groundwater flow velocity past the cylinder. In the absence of any flow past the device, the temperature on the surface of the probe will be independent of azimuth and symmetric about the vertical midpoint of the probe. The vertical midpoint will be warmer than the ends of the probe because of end effects. Groundwater flow past the device perturbs the temperature distribution, with the pattern and magnitude of the temperature variations reflecting the direction and magnitude of the groundwater flow velocity. In essence, warmer temperatures are observed on the downstream side of the probe than on the upstream side because the heat introduced into the formation by the heater is advected around the instrument.

24711 (CONF-920791–, pp. 5, Paper 23) **Crosshole seismic characterization and monitoring of an in situ air stripping waste remediation process.** Elbring, G.J. (Sandia National Labs., Albuquerque, NM (US)). USDOE Assistant Secretary for Environmental Restoration and Waste Management, Washington, DC (United States). Jul 1992. From Information exchange meeting on characterization sensors and monitoring technologies; Dallas, TX (United States); 15-16 Jul 1992. In *Proceedings of the information exchange meeting on characterization, sensors, and monitoring technologies.* 261p. Order Number DE93005318. Source: OSTI; NTIS.

New remediation technologies are also being developed and, along with them, methods for monitoring their physical processes and effectiveness need to be developed. In an effort to address both these concerns, crosshole seismic techniques are being developed and applied to assess their imaging capabilities. One of the new remediation technologies is being demonstrated at the Savannah River Site near Aiken, South Carolina. The technology involves the in situ air stripping of contaminated soils and groundwater. A leaking process sewer line contaminated the area under study with volatile chlorinated solvents, primarily trichloroethylene (TCE). To remove the contaminants, two horizontal wells were drilled. Air is injected into the lower well (53 meters deep) and a vacuum is applied to the upper well (20 meters deep) to extract the injected air. As the air passes through the subsurface, the TCE's are picked up and brought out the extraction well. The general geology underlying the site had been mapped through well logs from monitoring wells, but more information was needed between these wells. Little was known about the expected distribution of the air injected into the earth, and this distribution has a direct effect on which areas are remediated and also on the flow regimes set up during the air injection process. Several laboratory studies have shown that the degree of fluid saturation in a formation will affect both the seismic compressional (P) and shear (S) wave velocities, though to different extents. To take advantage of this property, P and S-wave surveys were conducted before the beginning of the air injection to provide a baseline and to image the site geology; and again during the air injection to measure changes caused by the injected air. In this way, paths travelled by the injected air in the subsurface could be imaged.

24712 (CONF-920791–, pp. 5, Paper 24) **The colloidal borescope an instrument for in situ assessment of local subsurface flow parameters.** Cronk, T.A. (Oak Ridge National Lab., TN (US)); Kearl, P.M. USDOE Assistant Secretary for Environmental Restoration and Waste Management, Washington, DC (United States). Jul 1992. From Information exchange meeting on characterization sensors and monitoring technologies; Dallas, TX (United States); 15-16 Jul 1992. In *Proceedings of the information exchange meeting on characterization, sensors, and monitoring technologies.* 261p. Order Number DE93005318. Source: OSTI; NTIS.

The colloidal borescope is designed to determine groundwater flow velocity (in the vector sense) by observing the advective transport velocity of indigenous micro-scale particles flowing through a screened well. The observed wellbore velocity is a direct result of the local specific discharge in the surrounding aquifer and, a site-specific determination of groundwater contaminant transport potential is thus achieved. The instrument consists of a charge coupled device (CCD) camera, optical magnification system, illumination source, and stainless steel housing. The device is approximately 60-cm long and has a diameter of 44 mm, facilitating use in a 5-cm observation well. After insertion into the observation well, the electronic image is transmitted to the surface where it is viewed on a 22.9-cm monitor and recorded on VHS tape for further analysis. The magnification factor of the system is 140X, which results in a field of view of approximately 1.0 mm x 1.4 mm x 0.1 mm. Comparison of the observed colloids with microspheres of known size indicates that the viewing size detection limit is on the order of 1 micron. Field use of the colloidal borescope consists of first lowering the instrument into an observation well to the desired depth of investigation. Orientation of the down-hole camera with respect to magnetic north is determined with a down-hole compass. After the depth and orientation of the field of view are determined, microscale flow fields through the wellbore are observed until initial turbulence, caused from instrument insertion, has subsided. Upon establishing steady-state flow, approximately twenty minutes of

flow data are recorded on VHS tape for further analysis. This process is repeated at various depths over the screened interval of an observation well and at various observation wells over a field site to provide a representative characterization of the underlying flow field.

24713 (CONF-920791–, pp. 6, Paper 25) **Electrical resistance tomography used in environmental restoration.** Ramirez, A. (Lawrence Livermore National Lab., CA (US)); Daily, W.; LaBrecque, D. USDOE Assistant Secretary for Environmental Restoration and Waste Management, Washington, DC (United States). Jul 1992. From Information exchange meeting on characterization sensors and monitoring technologies; Dallas, TX (United States); 15-16 Jul 1992. In *Proceedings of the information exchange meeting on characterization, sensors, and monitoring technologies.* 261p. Order Number DE93005318. Source: OSTI; NTIS.

The authors are developing a new imaging technique, Electrical Resistance Tomography (ERT), to map subsurface liquids as flow occurs during natural or clean-up processes; ERT can also be used to map geologic structure. Natural processes (such as surface water infiltrating the vadose zone) and clean-up processes (such as air injection in the saturated zone, steam injection, emplacement of subsurface barriers) can create changes in a soil's electrical properties that are readily measured. The authors use these measurements to calculate tomographs that show the spatial distribution of the subsurface resistivities The information derived from ERT can be used by remediation projects to: monitor the effectiveness of clean-up processes, characterize hydrologic processes affecting contaminant transport, select appropriate clean-up alternatives, demonstrate regulatory compliance, and to verify the installation and performance of subsurface barriers.

24714 (CONF-920791–, pp. 6, Paper 26) **The development of the high resolution S-wave reflection technique as a tool for improving subsurface characterization and groundwater studies.** Johnson, W.J. (Paul C. Rizzo Associates, Monroeville, PA (US)). USDOE Assistant Secretary for Environmental Restoration and Waste Management, Washington, DC (United States). Jul 1992. From Information exchange meeting on characterization sensors and monitoring technologies; Dallas, TX (United States); 15-16 Jul 1992. In *Proceedings of the information exchange meeting on characterization, sensors, and monitoring technologies.* 261p. Order Number DE93005318. Source: OSTI; NTIS.

The main objective of this research has been to develop the technology necessary to make high resolution S- wave profiling a useful tool in conducting the shallow groundwater investigations. Conventional seismic reflection technology using compressional (P-) waves has developed to the point where this technique has become a major component of numerous environmental assessments. Extending this technology to include shear (S-) waves offers the potential for greatly enhancing the data which can be extracted from the subsurface, in particular improving resolution and determining the fluid characteristics of subsurface layers. In some areas, thin clay layers can have a major impact on the groundwater flow. Similary, thin sand lenses within an otherwise confining medium can control the migration of contaminants. Thin subsurface layers, whether they are aquitards or aquifers, can be difficult targets for conventional and sampling programs. Sampling intervals normally used may be inadequate for dectecting thin beds and it is commonly difficult to prove the continuity of individual horizons boring on based alone. Geophysical methods are often used, especially to define continuity, but results are often unsatisfactory because of the lack of resolution. One of the most powerful tools for conducting an engineering or groundwater investigation is the high resolution seismic reflection technique. This method normally uses P-waves to provide acoustic images of the subsurface. Resolution is dependent on the frequency content of the waves and the velocity of the subsurface materials. This is also true if S-waves are used instead of P-waves. The difference is that the S-waves travel with different velocities and at different predominant frequencies, which implies that their ability to resolve subsurface levers will also be different. In general, the interpretation of groundwater conditions requires a comparison of P- and S-wave data.

24715 (CONF-920791–, pp. 3, Paper 30) **On-site analysis of metals in soils using stripping voltammetry.** Olsen, K.B. (Pacific Northwest Lab., Richland, WA (US)); Wang, J.; Setiadjii, R. US-DOE Assistant Secretary for Environmental Restoration and Waste Management, Washington, DC (United States). Jul 1992. From Information exchange meeting on characterization sensors and monitoring technologies; Dallas, TX (United States); 15-16 Jul 1992. In *Proceedings of the information exchange meeting on characterization, sensors, and monitoring technologies.* 261p. Order Number DE93005318. Source: OSTI; NTIS.

Screening methods are needed for field teams to use in identifying contaminated samples, thereby decreasing the number of samples and prioritizing those samples sent to the off-site analytical laboratory for chemical analysis. One such technology is being evaluated by DOE at the Mixed Waste Landfill Integrated Demonstration Project at Sandia National Laboratory: Stripping Voltammetry (SV) is being used to measure the concentrations of leachable chromium, uranium, lead, cadmium, copper, nickel, zinc, and cobalt in sediment leachate samples collected during drilling operations. Over the past few years, researchers at New Mexico State University has been developing methods for analyzing various metals in solutions using masking and stripping reagents that significantly increase specificity. For example, by utilizing 8-hydroxyquinoline as a complexing agent, uranium in groundwater can be measured at the part-per-billion level. New Mexico State University demonstrated SV capabilities at the Hanford Site by measuring chromium concentrations in groundwater at the well head using a mobile laboratory. A detection limit of 1 ppb was measured in the groundwater using the complexing agent diethylenetriaminepenta-acetic acid (DTPA). The measurement technique was simple and had a wide dynamic operating range. Because of the success associated with the measurement of chromium and uranium in ground water, the SV technique will be extended under this project supported by the DOE Office of Technical Development. The technique will be used to measure leachable chromium, uranium, lead, cadmium, copper, nickel, zinc, and cobalt in sediment samples as a field screening technique at Sandia National Laboratory's Chemical and Mixed Waste Landfills.

24716 (CONF-920791–, pp. 4, Paper 33) **Soil/sediment characterization of organic co-contaminants using coupled supercritical fluid extraction/optical detection (SFE/OD) systems.** Riley, R.G. (Pacific Northwest Lab., Richland, WA (US)). USDOE Assistant Secretary for Environmental Restoration and Waste Management, Washington, DC (United States). Jul 1992. From Information exchange meeting on characterization sensors and monitoring technologies; Dallas, TX (United States); 15-16 Jul 1992. In *Proceedings of the information exchange meeting on characterization, sensors, and monitoring technologies.* 261p. Order Number DE93005318. Source: OSTI; NTIS.

Throughout the more than forty years of nuclear fuels reprocessing at the Hanford Site's 200 West Area, an estimated 637 t of the volatile organic compound (VOC) carbon tetrachloride, co-mixed with similar quantities of other organic contaminants, including mono-, di-, and tributylphosphates; dibutylbutylphosphonate; and lard oil (a complex mixture of triglycerides), were disposed to cribs and trenches. Because the quantities released were so large, the co-disposed organic contaminants will have a significant effect on (1) the subsurface fate of VOCs and (2) the performance of in situ technologies to remediate VOCs in the vadose zone. Therefore, technologies are needed that (1) make characterization data available for contaminant screening and in-field technology deployment decision-making faster, (2) reduce costs (e.g., allowing sample characterization in the field as opposed to a remote laboratory), (3) reduce the amount of waste generated, and (4) address the problem of measurement of organic constituents in radioactively contaminated wastes, soils, and sediments. Supercritical fluid extraction (SFE) uses either pure carbon dioxide or carbon dioxide that contains small quantities of modifiers (organic chemicals such as methanol) at supercritical temperatures and pressures to extract contaminants from soils and sediments into a small amount of organic solvent. Optical detection (OD) techniques (e.g., infrared spectroscopy) are then used instead of chromatographic techniques (e.g., gas chromatography) to measure contaminants in the solvent, facilitating application in the field.

24717 (CONF-930371–Absts.) **Fourth annual Walker Branch Watershed research symposium: Program and abstracts.** Oak Ridge National Lab., TN (United States). Mar 1993. 46p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 4. annual Walker Branch Watershed research symposium; Oak Ridge, TN (United States); 18-19 Mar 1993. Order Number DE93009356. Source: OSTI; NTIS; INIS; GPO Dep.

The methods and concepts of watershed research, originally applied in an experimental or monitoring mode to relatively small catchments, are increasingly being used at larger scales and for specific applied problems. Research at Oak Ridge National Laboratory, the Tennessee Valley Authority, the US Forest Service, and other agencies and institutions participating in this symposium reflects research over a broad range of spatial scales that is being integrated through large-scale experiments along with computer modeling and graphical interfaces. These research projects address the basic atmospheric, geophysical, biogeochemical, and biological processes that regulate the responses of forested ecosystems to natural environmental variation and anthropogenic stresses. This symposium highlights the use of large-scale ecosystem experiments to address environmental issues of global concern. These experiments provide the only effective way to test models of ecosystem response that are based on the current state of knowledge of hydrology, biogeochemistry, plant physiology, and other ecosystem processes. Major environmental problems that are being addressed include acidic deposition and nitrogen loading (Bear Brook Watershed, Maine; and the Girdsjoen Covered Catchment, Sweden); climate warming (Soil Warming Experiment, Maine); and altered rainfall amounts (Savannah River Loblolly Pine Soil Water Manipulation and the Walker Branch Watershed Throughfall Displacement Experiment).

24718 (CONF-930403–33) **Human-factors-based implementation of the remote characterization system high-level control station.** Noakes, M.W. (Oak Ridge National Lab., TN (United States)); Richardson, B.S.; Rowe, J.C.; Draper, J.V.; Sandness, G.R. Oak Ridge National Lab., TN (United States). [1993]. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 5. topical meeting on robotics and remote systems; Knoxville, TN (United States); 26-29 Apr 1993. Order Number DE93010340. Source: OSTI; NTIS; INIS; GPO Dep.

The detection and characterization of buried objects and materials is an important first step in the restoration of the numerous US Department of Energy (DOE) and US Department of Defense waste disposal sites. DOE, through its Environmental Restoration and Waste Management Robotics and Technology Development Program, has developed the Remote Characterization System (RCS) to address the needs of remote subsurfacecharacterization. The RCS consists of a low-metal-content (low-metallic-signature) remotely piloted vehicle, a high-level control station (HLCS) where operators can remotely control the vehicle and analyze real-time data from sensors, and an array of sensors that can be chosen to meet the survey task at hand. Communication between the vehicle and the base station is handled by a radio link. Site mapping is made possible through the use of geopositioning satellite data. The primary mode of vehicle operation is teleoperation, but provision has been made for semiautonomous or supervisory control that allows for automated sitesurvey on simple sites. Data analysis and display is supported for both real-time observation and postprocessing of data. The particular emphasis of this paper documents the human-factors-based design influences on the HLCS and describes the design in detail.

24719 (CONF-930523–2) **Ecological investigation of a hazardous waste site, Warner Robins, Georgia.** Wade, M. (Oak Ridge National Lab., TN (United States)); Billig, P. Oak Ridge National Lab., TN (United States). [1993]. 16p. Sponsored by USDOE, Washington, DC (United States); Department of Defense, Washington, DC (United States). DOE Contract AC05-84OR21400. From 18. National Association of Environmental Professionals (NAEP) annual conference on current and future priorities for environmental management; Raleigh, NC (United States); 24-26 May 1993. Order Number DE93009663. Source: OSTI; NTIS; INIS; GPO Dep.

Landfill No. 4 and the sludge lagoon at Robins Air Force Base, Warner Robins, Georgia, were added to the United States Environmental Protection Agency (EPA) National Priorities List in 1987 because of highpotential for contaminant migration. Warner Robins is located approximately 90 miles southeast of Atlanta. In 1990 CH2M HILL conducted a Remedial Investigation at the base that recommended that further ecological assessment investigations be conducted (CH2M HILL 1990). The subject paper is the result of this recommendation. The ecological study was carried out by the Hazardous Waste Remedial Actions Program (HAZWRAP)Division of Martin Marietta Energy Systems, Inc., working jointly with its subcontractor CDM (CDM 1992a). The primary area of investigation (Zone 1) included the sludge lagoon, Landfill No. 4, the wetland area east of the landfill and west of Hannah Road (including two sewage treatment ponds), and the area between Hannah Road and Horse Creek (Fig. 1). The bottomland forest wetlands of Zone 1 extend from the landfill east to Horse Creek. Surface water and groundwater flow across Zone 1 is generally in an easterly direction toward Horse Creek. Horse Creek is a south-flowing tributary of the Ocmulgee River Floodplain. The objective of the study was to perform a quantitative analysis of ecological risk associated with the ecosystems present in Zone 1. This investigation was unique because the assessment was to be based upon many measurement endpoints resulting in both location-specific data and data that would assess the condition of the overall ecosystem. The study was segregated into five distinct field investigations: hydrology, surface water and sediment, aquatic biology, wetlands ecology, and wildlife biology.

24720 (CONF-930701–3) **Unusually amplified summer or winter indoor levels of radon.** Gammage, R.B.; Dudney, C.S.; Wilson, D.L. Oak Ridge National Lab., TN (United States). [1993]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 6. international conference on indoor air quality and climate; Helsinki (Finland); 4-8 Jul 1993. Order Number DE93010277. Source: OSTI; NTIS; INIS; GPO Dep.

The ratios of winter/summer indoor radon levels for houses in different regions of the southern Appalachians are characterized by individual log-normal distributions with geometric means both above and below unity. In some counties and cities, subpopulations of houses have unusually exaggerated winter/summer ratios of indoor radon, as well as high indoor radon levels, during periods of either warm or cool weather. It is proposed that in many instances, houses are communicating with larger than normal underground reservoirs of radon-bearing air in hilly karst terrains; differences between the outdoor and underground air temperatures are believed to provide density gradients producing aerostatic pressure differences for seasonally directed underground transport and subsequently elevated indoor radon. These seasonal movements of air are analogous to the well-known underground chimney effects, which produce interzonal flows of air inside caves.

24721 (CONF-930769–1) **Vapor stripping of VOC-contaminated clay soils.** West, O.R. (Oak Ridge National Lab., TN (United States)); Siegrist, R.L.; Lucero, A.J.; Jennings, H.L.; Schmunk, S.W. Oak Ridge National Lab., TN (United States). [1993]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 1993 joint Canadian Society of Civil Engineers-American Society of Civil Engineers (CSCE-ASCE) national conference on environmental engineering; Montreal (Canada); 12-14 Jul 1993. Order Number DE93011847. Source: OSTI; NTIS; INIS; GPO Dep.

Vapor stripping is a treatment process in which volatile organic contaminants (VOCs) are removed from contaminated soil by high-pressure aeration. This technology is potentially applicable to low-permeability soils when coupled with in situ soil mixing. A laboratory evaluation of in situ vapor stripping was conducted for TCE-contaminated deposits (>80% silt and clay, and hydraulic conductivity $\leq 10^{-6}$cm/sec) underlying a land disposal site located at a DOE facility. Intact soil cores taken from contaminated areas and re-packed soil cores spiked with TCE were treated in an apparatus that simulated the vapor stripping process. Removal efficiencies calculated from pre- and posttreatment samples were predominately greater than 85%. In some of the spiked cores, soil

samples were taken during treatment to establish removal efficiency as a function of treatment time.

24722 (DOE/ER/30196–3) **The influence of naturally-occurring organic acids on model estimates of lakewater acidification using the model of acidification of groundwater in catchments (MAGIC): Summary of research conducted during year 1.** Sullivan, T.J. (E and S Environmental Chemistry, Inc., Corvallis, OR (United States)); Eilers, J.M.; Cosby, B.J.; Driscoll, C.T.; Hemond, H.F. E and S Environmental Chemistry, Inc., Corvallis, OR (United States). 5 Mar 1993. 102p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-92ER30196. Order Number DE93013259. Source: OSTI; NTIS; INIS; GPO Dep.

A project for the US Department of Energy, entitled "Incorporation of an organic acid representation into MAGIC (Model of Acidification of Groundwater in Catchments) and Testing of the Revised Model UsingIndependent Data Sources" was initiated by E&S Environmental Chemistry, Inc. in March, 1992. Major components of the project include: improving the MAGIC model by incorporating a rigorous organic acid representation, based on empirical data and geochemical considerations, and testing the revised model using data from paleolimnological hindcasts of preindustrial chemistry for 33 Adirondack Mountain lakes, and the results of whole-catchment artificial acidification projects in Maine and Norway. The ongoing research in this project involves development of an organic acid representation to be incorporated into the MAGIC modeland testing of the improved model using three independent data sources. The research during Year 1 has included conducting two workshops to agree on an approach for the organic acid modeling, developing the organic subroutine and incorporating it into MAGIC (Task 1), conducing MAGIC hindcasts for Adirondack lakes and comparing the results with paleolimnological reconstructions (Task 2), and conducting site visits to the manipulation project sites in Maine and Norway. The purpose of this report is to provide a summary of the work that has been conducted on this project during Year 1. Tasks 1 and 2 have now been completed.

24723 (DOE/ER/60247–T4) **[A data collection program focused on hydrologic and meteorologic parameters in an Arctic ecosystem].** Kane, D. Alaska Univ., Fairbanks, AK (United States). [1992]. 24p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG06-84ER60247. Order Number DE93013241. Source: OSTI; NTIS; GPO Dep.

The hydrologic cycle of an arctic watershed is dominated by such physical elements as snow, ice, permafrost, seasonally frozen soils, wide fluctuations in surface energy balance and phase change of snow and ice to water. At Imnavait basin, snow accumulation begins in September or early October and maximum snowpack water equivalent is reached just prior to the onset of ablation in mid May. No significant mid winter melt occurs in this basin. Considerable snowfall redistribution by wind to depressions and valley bottom is evident. Spring snowmelt on the North Slope of Alaska is the dominant hydrologic event of the year.This event provides most of the moisture for use by vegetation in the spring and early summer period. The mechanisms and timing of snowmelt are important factors in predicting runoff, the migrations of birds and large mammals and the diversity of plant communities. It is important globally due to the radical and abrupt change in the surface energy balance over vast areas. We were able to explore the trends and differences in the snowmelt process along a transect from the Brooks Range to the Arctic Coastal plain. Snowpack ablation was monitored at three sites. These data were analyzed along with meteorologic data at each site. The initiation of ablation was site specific being largely controlled by the complementary addition of energy from radiation and sensible heat flux. Although the research sites were only 115 km apart, the rates and mechanisms of snowmelt varied greatly. Usually, snowmelt begins at the mid-elevations in the foothills and progresses northerly toward the coast and southerly to the mountains. In the more southerly areas snowmelt progressed much faster and was more influenced by sensible heat advected from areas south of the Brooks Range. In contrast snowmelt in the more northerly areas was slower and the controlled by net radiation.

24724 (DOE/ER/60727–T1) **Effects of egg incubation condition on the post-hatching growth and performance of the snapping turtle, Chelydra serpentina.** Ryan, K.M. State Univ. of New York, Buffalo, NY (United States). Dept. of Biology. Dec 1990. 76p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-88ER60727. Order Number DE93012037. Source: OSTI; NTIS; GPO Dep.

The effect of incubation temperature on the post-hatching growth and performance capacities of the common snapping turtle, Chelydra serpentina was investigated in the laboratory. Turtle eggs were collected from four sites in New York State and randomly assigned to four incubation temperature treatments to produce males (constant 26°C and downshifted 30-26-30°C) and females (constant 30°C and upshifted 26-30-26°C) under constant and altered temperature regimes. The incubation conditions resulted in 92% males from the constant 26°C group and 93% males from the downshifted group. 100% females resulted from both the constant 30°C group and the upshifted group. Turtles hatching from eggs incubated constantly at 26°C were significantly larger than hatchlings from eggs incubated at a constant 30°C or downshifted. Hatchlings were raised in individual aquaria at 25°C and fed earthworms and fish. After a 9-month growth period, turtles which had been incubated at a constant 30°C gained significantly more mass than did turtles from eggs which had been downshifted or upshifted. There was no extended effect of incubation condition on Post-hatching performance and learning ability as measured by righting and feeding responses. Thus, the mass gain differences seen in this study suggest that physiological differences do result as the consequence of incubation condition. However, these physiological differences are not reflected in normal locomotive or feeding behavior.

24725 (DOE/ER/60727–T2) **Energetics of free-living box turtles (Terrapene carolina) near Aiken, South Carolina.** Penick, D.N. (State Univ. of New York, Buffalo, NY (United States)). State Univ. of New York, Buffalo, NY (United States); Savannah River Ecology Lab., Aiken, SC (United States). Aug 1992. 92p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-88ER60727 ;AC09-76SR00819. Order Number DE93012038. Source: OSTI; NTIS; GPO Dep.

I measured field metabolic rates (FMR), water fluxes, and activity patterns of the box turtle Terrapene carolina on the Savannah River Plant, Aiken Co., SC, from September, 1987 to October, 1988. Doubly labeled water ($HT^{18}O$) measurements of production (field metabolic rates, FMR) of telemetered turtles were taken in conjunction with measurements of operative temperatures (T_e), turtle movement patterns, and micrometerological data consisting of air, litter, and substrate temperatures, solar and total radiation, and wind speed. Operative temperatures were used to predict standard (SMR) and maximum (MMR) metabolic rates, and these were compared to field metabolic rates (FMR) of box turtles in South Carolina. Turtles were inactive for most of the winter and for long periods of time during the rest of the year. Water fluxes (ml/kg*D) were 8.8, 18.9, and 26.4 in the winter, late spring, and early fall, respectively. There was no statistically significant sexual difference in FMR so these results were pooled for each season. Mean mass specific metabolic rates (ml CO_2/g*h) were 0.028, 0.0654, and 0.124 for the winter, spring, and fall, respectively. There was a significant difference in metabolic rates for the seasons of the year. In winter, FMR is substantially elevated above SMR and close to MMR, while in spring and fall FMRs are midway between SMR and MMR (SMR = 0.004, 0.010, and 0.017, and MMR = 0.034, 0.154, and 0.208 (ml CO_2/9*h) in the winter, spring, and fall, respectively). The low field metabolic rate of box turtles and low annual reproductive output is characteristic of a low energy specialist. This strategy may allow them to survive and flourish in an uncertain resource and reproductive environment by minimizing costs and risks, thereby maintaining greater lifetime reproductive output.

24726 (DOE/ER/60847–T1) **Stabilization of microorganisms for in situ degradation of toxic chemicals: Final report.** Crawford, R.L.; Ralston, D.R. Idaho Univ., Moscow, ID (United States). Center for Hazardous Waste Remediation Research. [1993]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG07-89ER60847. Order Number DE93013223. Source: OSTI; NTIS; INIS; GPO Dep.

Methods for large-scale microencapsulation of bacteria and nutrients into microbeads with small enough diameters to travel through aquifers have been developed at the University of Idaho. Both free

and immobilized cells of Flavobacterium ATCC 39723, a gram-negative aerobe that degrades various chlorinated phenols, into aquifer microcosms, through which pentachlorophenol (PCP)-contaminated groundwater flowed at in situ flow rates. Aquifer samples were collected with an auger from three wells at the University of Idaho Ground Water Research Site, and packed into 24 columns. Some sterile columns were also prepared, by irradiation at the Washington State University Radiation Center. In some of the columns the free Flavobacterium cells were mixed with the aquifer material before packing the columns. In others, agarose-microimmobilized Flavobacterium were mixed into the aquifer material. The effluent from each column was collected daily for 170 days and analyzed by UV spectroscopy or HPLC for remaining PCP. There were no statistically significant differences between the degradation rates of free or encapsulated Flavobacterium in sterile or native aquifer material as tested in these experiments. This work has shown at the lab scale that encapsulated PCP-degrading Flavobacterium were able to survive under conditions of starvation, predation, and lack of water.

24727 (DOE/ER/60977–4) **Simulation of landscape disturbances and the effect of climatic change: Final report, July 15, 1990–January 14, 1993.** Baker, W.L. Wyoming Univ., Laramie, WY (United States). Dept. of Geography and Recreation. Apr 1993. 122p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-90ER60977. Order Number DE93013374. Source: OSTI; NTIS; GPO Dep.

Altering the natural disturbance regime of a landscape produces changes in the structure of that landscape as the landscape adjusts to the new disturbance regime. A computer simulation model was designed to enable analyses of the longterm changes to be expected in landscapes as their disturbance regime changes. The model, DISPATCH, is the first dynamic spatial simulation model built around a geographical information system (GIS). The model also includes a new set of programs, the r.le programs, that is the first set of programs designed for calculating landscape structure measures within a GIS. The DISPATCH model was used, to analyze the effects of human alterations of disturbance regimes and global change on landscape structure. Landscapes do not adjust quickly to these alterations based on available data. Landscapes subjected to warming or to longterm fire suppression experience a decline in patch richness, Shannon diversity, the amount of edge and contrast, but an increase in distance between patches, angular second moment (texture measure) and patch size. In contrast, landscapes subjected to cooling, the short-term effects of fire suppression, fragmentation, or traditional prescribed burning tend to respond with increasing richness, Shannon diversity, edge, and contrast, but declining distance, angular second moment, and size. The pattern of response is different at different scales, with important implications for species.

24728 (DOE/ER/60991–T1) **Physiologically anaerobic microorganisms of the deep subsurface: Progress report, June 1, 1990–May 30, 1991.** Stevens, S.E. Jr.; Chung, K.T. Memphis State Univ., TN (United States). Dept. of Biology. Jun 1991. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG05-90ER60991. Order Number DE93015561. Source: OSTI; NTIS; GPO Dep.

This study seeks to determine numbers, diversity, and morphology of anaerobic microorganisms in 15 samples of subsurface material from the Idaho National Engineering Laboratory, in 18 samples from the Hanford Reservation and in 1 rock sample from the Nevada Test Site; set up long term experiments on the chemical activities of anaerobic microorganisms based on these same samples; work to improve methods for the micro-scale determination of in situ anaerobic microbial activity;and to begin to isolate anaerobes from these samples into axenic culture with identification of the axenic isolates.

24729 (DOE/ER/60991–T2) **Physiologically anaerobic microorganisms of the deep subsurface: Progress report, June 1, 1991–May 31, 1992.** Stevens, S.E. Jr.; Chung, K.T. Memphis State Univ., TN (United States). Dept. of Biology. Jun 1992. 41p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG05-90ER60991. Order Number DE93015562. Source: OSTI; NTIS; GPO Dep.

A variety of different media were used to isolate facultatively (FAB) and obligately anaerobic bacteria (OAB). These bacteria were isolated from core subsamples obtained from boreholes at the Idaho National Engineering Lab. (INEL) or at the Hanford Lab. (Yakima). Core material was sampled at various depths to 600 feet below the surface. All core samples with culturable bacteria contained at least FAB making thisthe most common physiological type of anaerobic bacteria present in the deep subsurface at these two sites. INEL core samples are characterized by isolates of both FAB and OAB. No isolates of acetogenic, methanogenic, or sulfate reducing bacteria were obtained. Yakima core samples are characterized by a marked predominance of FAB in comparison to OAB. In addition, isolates of acetogenic, methanogenic, and sulfate reducing bacteria were obtained. The Yakima site has the potential for complete anaerobic mineralization of organic compounds whereas this potential appears to be lacking at INEL.

24730 (DOE/ER/61484–5) **Small scale laboratory studies of flow and transport phenonmena in pores and fractures, Phase II: Second yearly progress report.** Wilson, J.L. New Mexico Inst. of Mining and Technology, Socorro, NM (United States). Apr 1993. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG03-92ER61484. Order Number DE93013295. Source: OSTI; NTIS; GPO Dep.

Small scale laboratory experiments, equipped with an ability to actually observe behavior on the pore level using microscopy, provide an economical and easily understood scientific tool to help us validateconcepts and assumptions about the transport of contaminants, and offers the propensity to discover heretofore unrecognized phenomena or behavior. The main technique employs etched glass micromodels, composed of two etched glass plates, sintered together, to form a two dimensional network of three dimensional pores. Flow and transport behavior is observed on a pore or pore network level, and recorded on film and video tape. This technique is coupled with related column studies. Specifically we're examining multiphase flow behavior of relevance, for example, to liquid-liquid mass transfer (solubilization of capillary trapped organic liquids); liquid-gas mass transfer (in situ volatilization); colloid movement, attachment and detachment in the presence of fluid-fluid interfaces; bacteria colonization and motility in porous systems; and heterogeneity effects on multi-phase flow, colloid movement and bacteria behavior.

24731 (DOE/ID/13167–T2) **Engineering considerations for the recovery of cesium from geologic materials.** Whalen, C. Jason Associates Corp., San Diego, CA (United States). 18 May 1993. 159p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-92ID13167. Order Number DE93015092. Source: OSTI; NTIS; GPO Dep.

Sorption coefficients for cesium in a variety of media have been compiled from a search of the open literature. The sorption coefficient, or K_d, is a description of a dissolved substance's tendency to attach to a solid substrate. The compilation of K_dS reported here for cesium demonstrate that this element readily sorbs ontogeological material. As a result of this sorption, the mass transport of cesium in the environment will be retarded. This retarded mass transport, characterized by the retardation factor, can be expected to be significant when compared to water velocities through porous-sorbing medium, such as geologic materials. K_dS for cesium are in the range of 100 mℓ/g up to 10,000 mℓ/g. K_dS are also an important parameter in the design of engineered systems for the purpose of recovering cesium from soils. The engineering design is based on a material-balance description of the extraction process. The information presented in this report provides a basis to predict the movement of cesium through geologic materials and also to design and predict the performance of extraction processes such as soil washing.

24732 (DOE/NV/10845–T11) **Prehistoric spatial patterning and subsistence studies: Archaeological investigations at Sample Unit U19arP4, Nevada Test Site, Nye County, Nevada.** Johnson, W.G.; DuBarton, A.; Edwards, S.; Drollinger, H. Nevada Univ., Reno, NV (United States). Quaternary Sciences Center. 1992. 60p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC08-90NV10845. Order Number DE93015315. Source: OSTI; NTIS; INIS; GPO Dep.

This report documents the methods and results of archaeological investigations at Sample Unit U19arP4 on Pahute Mesa at the Nevada Test Site (NTS). Eight sites were located there: four lithic artifact scatters (26NY1370, 26NY1372, 26NY3666 and 26NY3667), two temporary camps (26NY3665 and 26NY5418), one artifact locality (26NY5419), and one quarry (26NY3664). One of the lithic scatters, 26NY3667, incorporated a previously recorded rock ring, 26NY1371, that could not be relocated during subsequent investigations. Surface artifacts were collected from all but two of the sites, 26NY1370 and 26NY1372. The data retrieved from these investigations include over one thousand artifacts, such as projectile points, bifaces, debitage, groundstone, and pottery. The temporally diagnostic materials indicate periodic use of Sample Unit U19arP4 from the Middle Archaic to the Shoshonean period.

24733 (DOE/NV/10845–T12) **Archaeological investigations at Sample Unit U19aq, Nevada Test Site, Nye County, Nevada.** Jones, R.C.; DuBarton, A.; Holz, B.A.; Pippin, L.C.; Beck, C.M. Nevada Univ., Reno, NV (United States). Quaternary Sciences Center. 1992. 80p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC08-90NV10845. Order Number DE93015316. Source: OSTI; NTIS; INIS; GPO Dep.

This report documents the methods and results of archaeological investigations at sample unit U19aq on Pahute Mesa. Seven sites were studied: two lithic artifact scatters (26NY4577 and 26NY4584), two temporary camps (26NY4585 and 26NY4588), two rock rings (26NY4592 and 26NY4593), and two flakes (26NY7855). Surface artifacts were collected from all seven sites. Excavations were confined to one test pit at 26NY4584 and two test pits at 26NY4585. The data retrieved from these investigations include over eight thousand artifacts, such as projectile points, bifaces, debitage, groundstone, pottery and beads. The temporally diagnostic materials indicate periodic use of sample unit U19aq from 3250 B.P. to historic times. Most of the cultural remains reflect the specialized activities of hunters and gatherers occupying temporary camps.

24734 (DOE/NV/10845–T13) **The archaeology of drill hole U20bc, Nevada Test Site, Nye County, Nevada.** McLane, A.R.; Hemphill, M.L.; Livingston, S.J.; Pippin, L.C.; Walsh, L.A. Nevada Univ., Reno, NV (United States). Quaternary Sciences Center. 1992. 70p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC08-90NV10845. Order Number DE93015317. Source: OSTI; NTIS; INIS; GPO Dep.

Impacts to four sites near drill hole U20bc on Pahute Mesa in the northwestern part of the Nevada Test Site were mitigated through data recovery. The work was done during 1988 by the Desert Research Institute for the Department of Energy, Nevada Field Office (DOE/NV)- The four sites that warranted data recovery were 26NY3171, 26NY3173, 26NY5561 and 26NY5566. These sites had previously been determined eligible to the National Register of Historic Places. They were temporary camps that contained lithic debitage, projectile points, milling stones and pottery, and therefore contributed significant information concerning the prehistory of the area. The study of the archaeological remains shows that the prehistoric people subsisted on plant foods and game animals as determined by the artifacts including manos, metates, pottery, lithic scrapers, and projectile points. The time sensitive arfifacts (pottery and diagnostic points) suggest that the region was used from about 12,000 B.P. to just before the historic period, possibly 150 years ago. DOE/NV has met its obligation to mitigate adverse impacts to the cultural resources at U20bc. Therefore, it is recommended that this project proceed as planned.

24735 (DOE/NV/10845–T14) **Lithic technology studies: Archaeological research at drill hole U19ba, Nye County, Nevada.** Walsh, L.A.; Pippin, L.C.; Henton, G.H.; McLane, A. Nevada Univ., Reno, NV (United States). Quaternary Sciences Center. 1992. 84p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC08-90NV10845. Order Number DE93015318. Source: OSTI; NTIS; INIS; GPO Dep.

In 1989, the Desert Research Institute conducted two archaeological reconnaissances of drill hole U19ba on the Nevada Test Site (NTS) for the Department of Energy, Nevada Field Office (DOE/NV). Eighteen archaeological sites were located there, nine of which were collected when recorded. The DOE/NV chose to investigate these sites and requested a data recovery plan for 26NY4183, 26NY4184, 26NY5914, 26NY5916, 26NY5917, and 26NY5922. Field investigations, primarily controlled surface collections, were carried out in May 1990 and, in the process, another two sites, 26NY7357 and 26NY7358, were discovered. Theses studies focused on core-biface technology, cultural thermal alteration, techniques used to analyze lithic debitage, and the recovery of small sized artifacts. Results of these analyses indicate that flake blanks produced from cores were an important component of biracial technology at these sites, thermal alteration was important throughout the reduction sequence, the techniques used to analyze debitage mask variability, and that the recovery of small sized artifacts reveals biracial final finishing and notching activity at 26NY5917. Based on projectile point chronology, the project area was periodically visited from about 7,000 years ago to about 400 years ago.

24736 (DOE/NV/10845–T15) **Archaeological investigations at drill hole U19bg, Nevada Test Site Nye County, Nevada.** Klimowicz, J.; Pippin, L.C.; Henton, G.J.; Walsh, L.A. Nevada Univ., Reno, NV (United States). Quaternary Sciences Center. 1992. 60p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC08-90NV10845. Order Number DE93015319. Source: OSTI; NTIS; INIS; GPO Dep.

In 1983 and 1989, the Desert Research Institute conducted cultural resources reconnaissances of the U19bg drill hole area on the Nevada Test Site for the Department of Energy, Nevada Field Office (DOE/NV). These reconnaissances identified several archaeological sites, two of which were considered eligible to the National Register of Historic Places. DOE/NV chose to mitigate adverse impacts to one of these, 26NY3391, through a data recovery program. Fieldwork was conducted in June, 1990 and data analysis continued through the spring of 1991. This report presents the results of the data recovery at drill hole U19bg. The artifact analyses indicate that the area was repeatedly occupied by prehistoric inhabitants for about 7,000 years, from approximately 8,000 to 800 years ago. The principal activity at the sites, lithic tool production and refinishing, remained relatively constant through time.

24737 (DOE/NV/10845–T16) **Temporary camps at drill hole U19aq on Pahute Mesa, Nye County, Nevada.** Pippin, L.C.; Reno, R.L.; Henton, G.H.; Hemphill, M.; Lockett, C.L. Nevada Univ., Reno, NV (United States). Quaternary Sciences Center. 1992. 142p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC08-90NV10845. Order Number DE93015591. Source: OSTI; NTIS; GPO Dep.

The US Department of Energy, Nevada Field Office, has proposed a nuclear test at drill hole U19aq (902100N/585000E, Nevada Coordinate System, Central Zone) on Pahute Mesa, Nevada Test Site, Nevada. In compliance with Section 106 of the National Historic Preservation Act, the DOE/NV had the Quatenary Sciences Center, Desert Research Institute, identify and evaluate the potential effects of this activity on cultural resources. To determine the nature of cultural resources in the area, DRI conducted a Class III intensive archaeological survey of an approximately 1-km^2 area around the drill hole. That survey, conducted in June 1985, located and recorded 20 archaeological sites. Two of those sites, interpreted as temporary camps of ancient hunters and gatherers, covered an extensive portion of the area proposed for nuclear testing. Half the sites were small concentrations of artifacts or isolated artifacts and were collected at the time of their discovery and 10 sites were left in place. Those sites were in danger of being adversely affected by the land-disturbing activities proposed at the drill hole. In August and September 1985, DRI conducted limited test excavations (15 test units) at those sites to further evaluate their scientific significance and to provide information that could be used in designing a plan for data recovery.

24738 (DOE-RAS–92.007) **The role of the plant litter layer in the recycling of radiocaesium in upland habitats.** Horrill, A.D. (Institute of Terrestrial Ecology, Grange-on-Sands (United Kingdom). Merlewood Research Station); Kennedy, V.H.; Dent, T.L.; Thomson, A.J. Department of the Environment, London (United Kingdom). Radioactive Substances Div. Aug 1992. [56p.] Contract

PECD-7/9/522;Project ITE T07050H5. Order Number DE93625615. Source: OSTI; NTIS (US Sales Only); INIS.

Field and laboratory studies have been used to investigate the role of the plant litter layer in upland habitats. Radiocaesium, deposited unhomogeneously, by the Chernobyl accident, ranged from 1 3000 - 2 400 Bq kgsup(-1) in a range of plant litters in May 1992. In the field 45% of the ^{137}Cs in heather litter was released over a two year period. Litter leachates contained 0.1 -0.7 Bq 1^{-1} of ^{137}Cs. Microbial population size has also been shown to affect ^{137}Cs release rates in laboratory experiments on heather and spruce litter. ^{137}Cs distribution within litter has been investigated by sequential extraction techniques and it was shown that there is a potential long term immobilization of c. 20% of litter ^{137}Cs by the lignin component. (author).

24739 (DOE/SR/15191–6) **Wildlife Management Assistance Program: Final technical report, July 1, 1987–June 30, 1992.** Caudell, M.B. South Carolina Wildlife and Marine Resources Dept., Columbia, SC (United States). Aug 1992. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG09-87SR15191. Order Number DE93015583. Source: OSTI; NTIS; GPO Dep.

This report details activities in administering Savannah River Site public lands for wildlife management. Accomplishments in administering hunts, gathering biological data, and in coordinating land use are described.

24740 (DOE/SR/15191–7) **Natural resources management activity and biodiversity maintenance: Progress report, July 1, 1992–June 30, 1993.** Caudell, M.B. South Carolina Wildlife and Marine Resources Dept., Columbia, SC (United States). May 1993. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG09-87SR15191. Order Number DE93015564. Source: OSTI; NTIS; GPO Dep.

Activities in coordinating land use for the Savannah River Site public lands during the period of July 1, 1992 to June 30, 1993 are reported.

24741 (DOE/SR/18159–2) **The effects of soil mineral phases on the abiotic degradation of selected organic compounds: Annual progress report.** Sandu, S.S. Claflin Coll., Orangeburg, SC (United States). Jun 1992. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG09-90SR18159. Order Number DE93015621. Source: OSTI; NTIS; GPO Dep.

Tetraphonylboron (TPB) will be used to precipitate radioactive 137Cs from high level nuclear waste water, at the Defense Waste Processing Facility (DWPF) which is operated by the US Department of Energy (US DOE), at the Savannah River Site (SRS), Aiken, SC. The decontaminated wastewater will contain millimolar quantities of TPB that will be processed into salt concretions. The waste processing operations will require about 3×10^5 kg/yr of TPB during its full scale operation. The transportation and use of large amounts of TPB can potentially result in the release of TPB into soil or aquatic environments where its degradation will take place. Previous studies have shown that TPB degrades abiotically in soils; however, the role of specific mineral surfaces in mediating the reaction kinetics and mechanisms for the abiotic degradation of TPB are not clearly known. Laboratory studies have been undertaken to evaluate the surface facilitated degradation of TPB by aluminum silicate clay minerals-kaolinite and montmorillonite. Preliminary results indicate that the rate of degradation of TPB is much higher in kaolinite-a single layer mineral-than in montmorillonite - a double layer mineral- and Orangeburg loamy soil. The initial products of TPB degradation in both minerals are diphenylboric acid (DPBA) and biphenyl. However, HPLC monitoring of degradation products of TPB in montmorillonite appears to indicate the presence of phenol and monophenyboric acid (MPBA).

24742 (DOE/SR/18271–1) **Degradation of mix hydrocarbons by immobilized cells of mix culture using a trickle fluidized bed reactor: Annual progress report, June 1992–May 1993.** Chapatwala, K.D. Selma Univ., AL (United States). Div. of Natural Sciences. [1993]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG09-92SR18271. Order Number DE93015592. Source: OSTI; NTIS; GPO Dep.

The microorganisms, capable of degrading mix hydrocarbons were isolated from the soil samples collected from the hydrocarbon contaminated sites. The mix cultures were immobilized in calcium alginate solution in the form of beads. A trickle fluidized bed air-uplift-type reactor designed to study the degradation of mix hydrocarbons was filled with 0.85% normal saline containing the immobilized cells of mix culture. The immobilized beads were aerated with CO_2-free air at 200 ml/min. The degradation of different concentrations of hydrocarbons in the presence/absence of commercially available fertilizers by the immobilized cells of mix culture is now in progress.

24743 (EGG–10617-2187) **Distribution, life history, management, and current status of Astragalus beatleyae on the US Department of Energy's Nevada Test Site.** Blomquist, K.W.; Wills, C.A.; Ostler, W.K.; Rautenstrauch, K.R.; O'Farrell, T.P. EG and G Energy Measurements, Inc., Goleta, CA (United States). Santa Barbara Operations. Nov 1992. 42p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC08-88NV10617. Order Number DE93007553. Source: OSTI; NTIS; GPO Dep.

A beatleyae is a small milk vetch found in south-central Nevada on portions of the Nevada Test Site (NTS) and Nellis Air Force Range. This species has been classified as a Category 1 candidate species for federal listing under the Endangered Species Act because of its limited range and threats from human activities, primarily activities conducted by the US Department of Energy, Nevada Field Office (DOE/NV). The status of A. beatleyae was last evaluated over 13 years ago (Rhoads et al., 1979, Beatley, 1978). Since then, numerous conservation measures have been taken by DOE/NV and additional information on the status of this population has been obtained. Field surveys have been conducted to locate new populations of A. beatleyae. Because of this work, the known range of this species has been expanded approximately 300%. DOE/NV has established. a conservation agreement with the US Fish and Wildlife Service and developed a Species Management Plan. This report is a presentation of the results of that population monitoring study. Also included in this report are a review of other field investigations and conservation measures taken by DOE/NV, a review of the current threats to A. beatleyae, and a reassessment of the status of this species under the Endangered Species Act.

24744 (EGG-ESQ–10614) **Summary report: Assessment of deep injection well associated surface soils at the Idaho National Engineering Laboratory.** Pole, S.B. EG and G Idaho, Inc., Idaho Falls, ID (United States). Jan 1993. 102p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-76ID01570. Order Number DE93010756. Source: OSTI; NTIS; INIS; GPO Dep.

This report summarizes sampling activities and analytical results of the chemical and radiological content of surface soils from storm water retention basins and drainage ditches associated with eight deep injection wells at the Idaho National Engineering Laboratory. The results of the sampling effort were intended to support permitting of the injection wells by the State of Idaho Department of Water Resources. In August 1992, the surface soils associated with eight storm water retention basins and ditches were sampled. All samples were collected and analyzed in accordance with a written sampling and analysis plan. The samples were analyzed by an off-Site contract laboratory, and the results were compared to local and regional soil analytical data to determine the presence of contaminants. The results indicated that the surface soils from the storm water retention basins and ditches did not have concentrations of metals or radionuclides greater than the range of concentrations found in local and regional soils. Volatile organic compounds were below detection limits.

24745 (EMO–1096-Vol.1) **Shemya AFB, Alaska 1992 IRP field investigation report: Volume 1: Final report.** Pacific Northwest Lab., Richland, WA (United States). Environmental Management Operations; Air Force Alaskan Air Command, Elmendorf AFB, AK (United States); CH2M Hill, Boise, ID (United States). Feb 1993. 340p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract AC06-76RL01830. DEU-91-06. Order Number DE93011968. Source: OSTI; NTIS; INIS; GPO Dep.

The US Air Force is currently investigating 22 sites on Shemya Air Force Base (AFB) to determine if past spill and disposal activities have caused environmental damage. These investigations are being carried out under the Air Force's Installation Restoration Program (IRP). As a part of the IRP program, field investigations were performed in 1992 to obtain the information needed to assess what future actions willneed to be carried out at each site. The island's drinking water supply was also investigated. Activities completed at 10 selected sites during the 1992 field investigation included surface sampling to determine the lateral extent of contamination, subsurface sampling to determine the vertical extent of contamination, and the installation of well points and monitoring wells to determine the direction of groundwater flow and if the groundwater has been affected by a site. In addition, geophysical surveys were performed at most sites to identify site boundaries and check for the presence of buried metal to be avoided during drilling activities.

24746 (EMO–1096-Vol.3) **Shemya AFB, Alaska 1992 IRP field investigation report: Volume 3, Appendixes B, C, and D: Final report.** Pacific Northwest Lab., Richland, WA (United States). Environmental Management Operations; Air Force Alaskan Air Command, Elmendorf AFB, AK (United States); CH2M Hill, Boise, ID (United States). Feb 1993. 547p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract AC06-76RL01830. DEU-91-06. Order Number DE93011970. Source: OSTI; NTIS; INIS; GPO Dep.

The US Air Force is currently investigating 22 sites on Shemya Air Force Base (AFB) to determine if past spill and disposal activities have caused environmental damage. These investigations are being carried out under the Air Force's Installation Restoration Program (IRP). Field investigations were performed in 1992 to obtain the information needed to assess what future actions will need to be carried out at each site. The island's drinking water supply was also investigated. Activities completed at 10 selected sites included surface sampling to determine the lateral extent of contamination, subsurface sampling to determine the vertical extent of contamination, and the installation of well points and monitoring wells to determine the direction of groundwater flow and if the groundwater has been affected by a site. Geophysical surveys were performed at most sites to identify site boundaries and check for the presence of buried metal to be avoided during drilling activities. This report, appendices B, C, and D contains information on the following: geophysical contour maps and profile plots; human health risk assessment; and ecological risk assessment.

24747 (EMO–1096-Vol.4) **Shemya AFB, Alaska 1992 IRP field investigation report: Volume 4, Appendixes E and F: Final report.** Pacific Northwest Lab., Richland, WA (United States). Environmental Management Operations; Air Force Alaskan Air Command, Elmendorf AFB, AK (United States); CH2M Hill, Boise, ID (United States). Feb 1993. 328p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract AC06-76RL01830. DEU-91-06. Order Number DE93011971. Source: OSTI; NTIS; INIS; GPO Dep.

The US Air Force is currently investigating 22 sites on Shemya Air Force Base (AFB) to determine if past spill and disposal activities have caused environmental damage. These investigations are being carried out under the Air Force's Installation Restoration Program (IRP). Field investigations were performed in 1992 to obtain the information needed to assess what future actions will need to be carried out at each site. The island's drinking water supply was also investigated. Activities completed at 10 selected sites included surface sampling to determine the lateral extent of contamination, subsurface sampling to determine the vertical extent of contamination, and the installation of well points and monitoring wells to determine the direction of groundwater flow and if the groundwater has been affected by a site. In addition, geophysical surveys were performed at most sites to identify site boundaries and check for the presence of buried metal, to be avoided during drilling activities. This report contains appendices E and F with information on the following: soil boring logs, and data validation of samples analyzed.

24748 (ES/ER/TM–55) **An innovative approach to multimedia waste reduction: Measuring performance for environmental cleanup projects.** Phifer, B.E. Jr. (Oak Ridge K-25 Site, TN (United States)); George, S.M. Oak Ridge K-25 Site, TN (United States); Weston (Roy F.), Inc., Oak Ridge, TN (United States). Apr 1993. 18p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93011693. Source: OSTI; NTIS; INIS; GPO Dep.

One of the greatest challenges we now face in environmental cleanup is measuring the progress of minimizing multimedia transfer releases and achieving waste reduction. Briefly, multimedia transfer refers to the air, land, and water where pollution is not controlled, concentrated, and moved from one medium to another. An example of multimedia transfer would be heavy metals in wastewater sludges moved from water to land disposal. Over $2 billion has been budgeted for environmental restoration site cleanups by the Department of Energy (DOE) for FY 1994. Unless we reduce the huge waste volumes projected to be generated in the near future, then we will devote more and more resources to the management and disposal of these wastes. To meet this challenge, the Martin Marietta Energy Systems, Inc., Oak Ridge Environmental Restoration (ER) Program has explored the value of a multimedia approach by designing an innovative Pollution Prevention Life-Cycle Model. The model consists of several fundamental elements (Fig. 1) and addresses the two major objectives of data gathering and establishing performance measures. Because the majority of projects are in the remedial investigation phase, the focus is on the prevention of unnecessary generation of investigation-derived waste and multimedia transfers at the source. A state-of-the-art tool developed to support the life-cycle model for meeting these objectives is the Numerical Scoring System (NSS), which is a computerized, user-friendly data base system for information management, designed to measure the effectiveness of pollution prevention activities in each phase of the ER Program. This report contains a discussion of the development of the Pollution Prevention Life-Cycle Model and the role the NSS will play in the pollution prevention programs in the remedial investigation phase of the ER Program at facilities managed by Energy Systems for DOE.

24749 (JAERI-M–93-034) **Radionuclide migration behavior at the low adsorption region on the aerated soil testing, 2: Effect of inflow volume and migration analysis.** Takebe, Shinichi (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Tokai Research Establishment); Mukai, Masayuki; Komiya, Tomokazu; Kamiyama, Hideo. Japan Atomic Energy Research Inst., Tokyo (Japan). Feb 1993. 20p. (In Japanese). Order Number DE93797601. Source: OSTI; NTIS; INIS.

Migration test of desorbed radionuclides from a soil layer, contaminated with ^{60}Co, ^{85}Sr and ^{137}Cs, by using large column soil samples taken out in the undisturbed state, was continued. Radionuclide migration behavior at the low adsorption region were investigated of reduced inflow volume of the ground water just before the breakthrough of tritiated water. Integrated analysis was made for all testing results of migration concentration profile in the soil layer, and effluent concentration profile on elapsed time. ^{85}Sr and ^{137}Cs were not observed in the deeper soil layer of the column at such a low inflow volume, ^{60}Co showed a low concentration migration profile with a concentration peak in the deeper soil layer. The migration behavior of ^{60}Co at the low adsorption region was analyzed by using a non-equilibrium migration model taking in consideration of sorption and desorption rates and a maximum sorption capacity. This model was able to explain consistently all the test results in account of the migration of movable non-cationic form of ^{60}Co. Initial fraction of the movable form in the contaminated soil layer was estimated to be around 0.1 %. (author).

24750 (KCP–613-4857) **Annual site environmental report for calendar year 1991, Kansas City Plant, Kansas City, Missouri.** Allied-Signal Aerospace Co., Kansas City, MO (United States). Kansas City Div. May 1992. 250p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00613. Order Number DE93012378. Source: OSTI; NTIS; GPO Dep.

The purpose of this report is to present a summary of the environmental data for the Kansas City Plant, characterize site environmental management performance, provide compliance status with applicable environmental standards and requirements, and highlight significant achievements, programs, and efforts which go beyond regulatory requirements. This monitoring program is designed to measure non-radiological releases to the air, water

(surface and ground), and soil during historical/routine operations and to detect any accidental non-radioactive releases. One hundred sixty three monitoring wells (some with multiple completions), five sampling points at the uv/ozone system, three ambient air monitoring stations, and sampling results from four outfalls, nine surface water sites, and one sanitary discharge are used in the monitoring program. No radioactive materials are machined or processed at this plant.

24751 (KFKI–1992-20/K) **A new method for the determination of radionuclide distribution in the soil by in situ gamma-ray spectrometry.** Zombori, P. (Hungarian Academy of Sciences, Budapest (Hungary). Central Research Inst. for Physics); Andrasi, A.; Nemeth, I. Hungarian Academy of Sciences, Budapest (Hungary). Central Research Inst. for Physics. Jun 1992. [38p.] Order Number DE93625616. Source: OSTI; NTIS (US Sales Only); INIS.

A method was searched for to estimate the penetration characteristics of fallout radioactivity, using only spectral information obtained by in situ spectrometric measurements, and avoiding the need for long and tiresome sampling and sample analysis procedures. To speed up the analysis for depth distribution determination of fallout radioactivity in soil, an instrumental method based on the shape of spectra was developed. The ratio of peak to valley (the region between the photopeak and Compton edge) depends on the penetration of radionuclides in soil, providing an estimation of depth profile. These ratios were calculated and the method was tested by actual measurements. (R.P.) 7 refs.; 14 figs.; 2 tabs.

24752 (K/SUB–90-NH989/2) **1990 annual ground-water report K-1407-B and K-1407-C interim status units Oak Ridge K-25 Site.** Oak Ridge K-25 Site, TN (United States); Geraghty and Miller, Inc., Oak Ridge, TN (United States). Feb 1991. 83p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OT21400. Order Number DE93012196. Source: OSTI; NTIS; INIS; GPO Dep.

The Tennessee Department of Health and Environment (TDHE) Rules Governing Hazardous Waste Management require that specific ground-water information for interim status units be reported in conjunction with the annual hazardous waste treatment, storage, and disposal report (TN 1200-1-11-.05(6)(e)1 and 2). To be included in the report are, the data from annual/semiannual ground-water sampling, results of statistical analyses, and an evaluation of ground-water surface elevations for units in detection monitoring. Martin Marietta Energy Systems, Inc. manages the K-25 Site in Oak Ridge, Tennessee for the Department of Energy. Two interim status units at K-25 require ground-water monitoring, the K-1407-B and K-1407-C Holding Ponds. Both of these units were surface impoundments that have been drained and the waste sludges removed in response to the November 8, 1988, interim status closure milestone. The K-1407-C Pond was drained in mid-1987 and sludge removal activities were completed in November of 1988. The K-1407-B Pond was drained inOctober 1988, and sludge removal activities were completed in August of 1989. Both units have undergone soil sampling to verify complete sludge removal which would allow them to be "clean closed" under interim status regulations. Analytical results of soil samples from K-1407-C Pond are currently being evaluated and soil samples from K-1407-B Pond are undergoing laboratory analysis at this time. This report presents the results of the ground-water monitoring conducted at each unit in compliance with interim status regulations.

24753 (LA–12416-MS) **Elemental composition of background soils from Arches National Park, Utah.** Gladney, E.S. (Los Alamos National Lab., NM (United States)); Ferenbaugh, R.W.; Belnap, J. Los Alamos National Lab., NM (United States). May 1993. 21p. Sponsored by Department of the Interior, Washington, DC (United States). DOE Contract W-7405-ENG-36. Order Number DE93011038. Source: OSTI; NTIS; GPO Dep.

Background elemental data on soil composition at Arches National Park are reported. The enrichment factor analysis of the soil data from Arches National Park provides some interpretation of the current elemental status of soils at the park. These data provide a basis for determining changes in elemental enrichment status in the future.

24754 (LA–12417-MS) **An investigation of sulfur concentrations in soils and pine needles in Bandelier National Monument, New Mexico.** Gladney, E.S. (Los Alamos National Lab., NM (United States)); Ferenbaugh, R.W.; Jones, E.A.; Bell, M.G.; Morgan, J.D.; Stallings, E.A.; Nelson, L.A.; Lundstrom, C.; Bowker, R.G. Los Alamos National Lab., NM (United States). Mar 1993. 48p. Sponsored by Department of the Interior, Washington, DC (United States). DOE Contract W-7405-ENG-36. Agreement 0475-4-8009. Order Number DE93011990. Source: OSTI; NTIS; INIS; GPO Dep.

Sulfur measurements in different age groups of pinon pine needles and adjacent soil samples from ten sampling sites at Bandelier National Monument were determined using combustion elemental analysis and chromatographic techniques. The primary goal was to establish base-line levels for elemental sulfur in the Monument. Sulfur levels in foliage and soils were evaluated using analysis of variance techniques. Foliage sulfur concentrations differed significantly among the 10 sampling sites and among trees within sites; however, needles of different ages did not differ significantly in sulfur content. Average soil concentrations were very low, approximately 12% of the average needle concentrations. Soil sulfur concentrations also differed significantly among the 10 sampling sites and at different depths in the soil. No statistical differences were evident in soils sampled at the four compass points (N,S,E,W) around each tree. These differences imply that large numbers of samples are needed to identify small effects from anthropogenic inputs of sulfur into the system or that the effects must be large relative to the differences among sampling sites and individual trees in order to be detected.

24755 (LA–12418-MS) **An investigation of sulfur concentrations in soils and pine needles in Canyonlands National Park, Utah.** Gladney, E.S. (Los Alamos National Lab., NM (United States)); Ferenbaugh, R.W.; Jones, E.A.; Bell, M.G.; Morgan, J.D.; Nelson, L.A.; Lundstrom, C.; Bowker, R.G. Los Alamos National Lab., NM (United States). Mar 1993. 46p. Sponsored by Department of the Interior, Washington, DC (United States). DOE Contract W-7405-ENG-36. Order Number DE93011992. Source: OSTI; NTIS; INIS; GPO Dep.

Sulfur measurements in different age groups of pinon pine needles and adjacent soil samples from ten sampling sites at Canyonlands National Park were determined using combustion elemental analysis and chromatographic techniques. The primary goal was to establish base-line levels for elemental sulfur in the Park. Sulfur levels in foliage and soils were evaluated using analysis of variance techniques. No significant differences were found in foliage sulfur concentrations among the 10 sampling sites; however, trees within sites were significantly different. Needles of different ages did not differ significantly in sulfur content. Average soil concentrations were very low, approximately 4% of the average needle concentrations. Soil sulfur concentrations also differed significantly among the 10 sampling sites and at different depths in the soil. No statistical differences were evident in soils sampled at the four compass points (N,S,E,W) around each tree. These differences imply that large numbers of samples are needed to identify small effects from anthropogenic inputs of sulfur into the system, or that the effects must be large relative to the differences among sampling sites and individual trees in order to be detected.

24756 (LA–12419-MS) **An investigation of sulfur concentrations in soils and pine needles in Chaco Culture National Historical Park, New Mexico.** Gladney, E.S. (Los Alamos National Lab., NM (United States)); Ferenbaugh, R.W.; Jones, E.A.; Bell, M.G.; Morgan, J.D.; Nelson, L.A.; Bowker, R.G. Los Alamos National Lab., NM (United States). Mar 1993. 46p. Sponsored by Department of the Interior, Washington, DC (United States). DOE Contract W-7405-ENG-36. Order Number DE93011991. Source: OSTI; NTIS; INIS; GPO Dep.

Sulfur measurements in different age groups of pinon pine needles and adjacent soil samples from ten sampling sites at Chaco Culture National Historical Park were determined using combustion elemental analysis and chromatographic techniques. The primary goal was to establish base-line levels for elemental sulfur in the Park. Sulfur levels in foliage and soils were evaluated using analysis of variance techniques. No significant differences were found in

foliage sulfur concentrations among the 10 sampling sites; however, trees within sites were significantly different. Needles of different ages did not differ significantly in sulfur content. Average soil concentrations were low, approximately 30% of the average needle concentrations. Soil sulfur concentrations did not differ significantly among the 10 sampling sites; however, different depths in the soil had statistically different concentrations of sulfur. No statistical differences were evident in soils sampled at the four compass points (N,S,E,W) around each tree. These differences imply that large numbers of samples are needed to identify small effects from anthropogenic inputs of sulfur into the system or that the effects must be large relative to the differences among sampling sites and individual trees in order to be detected.

24757 (LA–12498-PR) **Laboratory and field studies related to the Hydrology/Radionuclide Migration Project: Progress report, October 1, 1991–September 30, 1992.** Thompson, J.L. (comp.) (ed.). Los Alamos National Lab., NM (United States). Jan 1993. 33p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. Order Number DE93008078. Source: OSTI; NTIS; INIS; GPO Dep.

The research done in FY 1992 at Los Alamos as part of the Hydrology/Radionuclide Migration Project is detailed in this report. We describe our work in support of the Department of Energy defense and environmental restoration programs at the Nevada Test Site. The Appendix of this report lists meetings attended, documents prepared or reviewed, and articles published during FY 1992. We evaluated the extent of tritium concentration gradients in piezometer tubes in hole UE3e#4 and observed the lack of tritium and ^{85}Kr in holes UE4t and UE20bh-1. We measured the tritium and fission product distributions as a function of depth in the re-entry hole U4ups2a and collected samples that in-dicate that a large fraction of fission product radionuclides in the water at this site are associated with particulates and are not in solution. We have prepared a history of holes drilled in Yucca Flat that details the effects of water confined at high pressure in certain tuff units there. Our work at the Cambric site is continuing; this year we observed small changes in the concentrations of tritium, ^{85}Kr, and ^{137}Cs resulting from the absence of pumping at this site. We analyzed debris from a recent nuclear test to determine the spatial distribution of fission products and their leachability into groundwater.

24758 (LA-SUB–93-38) **On application of SAMFT1D and SAMFT2D codes to the carbon tetrachloride data from Westinghouse Hanford Corporation of the 200 West Area at Hanford.** Yushu Wu (HydroGeoLogic, Inc., Herndon, VA (United States)). Los Alamos National Lab., NM (United States); HydroGeoLogic, Inc., Herndon, VA (United States). Jun 1992. 38p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. Order Number DE93008000. Source: OSTI; NTIS; INIS; GPO Dep.

Environmental transport of Carbon Tetrachloride thru soils at the Hanford Reservation is described. The SAMFTID code was utilized. Boundary conditions, relative permeability, capillary pressure, porosity and permeability, and grid design are described.

24759 (LA-SUB–93-76) **Ecological risk assessment of depleted uranium in the environment at Aberdeen Proving Ground: Annual report, 1991.** Clements, W.H. (Colorado State Univ., Fort Collins, CO (United States). Dept. of Fishery and Wildlife Biology); Kennedy, P.L.; Myers, O.B. Los Alamos National Lab., NM (United States); Colorado State Univ., Fort Collins, CO (United States). Dept. of Fishery and Wildlife Biology. [1993]. 32p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract W-7405-ENG-36. Order Number DE93008911. Source: OSTI; NTIS; INIS; GPO Dep.

A preliminary ecological risk assessment was conducted to evaluate the effects of depleted uranium (DU) in the Aberdeen Proving Ground (APG) ecosystem and its potential for human health effects. An ecological risk assessment of DU should include the processes of hazard identification, dose-response assessment, exposure assessment, and risk characterization. Ecological risk assessments also should explicitly examine risks incurred by nonhuman as well as human populations, because risk assessments based only on human health do not always protect other species. To begin to assess the potential ecological risk of DU release to the environment we modeled DU transport through the principal components of the aquatic ecosystem at APG. We focused on the APG aquatic system because of the close proximity of the Chesapeake Bay and concerns about potential impacts on this ecosystem. Our objective in using a model to estimate environmental fate of DU is to ultimately reduce the uncertainty about predicted ecological risks due to DU from APG. The model functions to summarize information on the structure and functional properties of the APG aquatic system, to provide an exposure assessment by estimating the fate of DU in the environment, and to evaluate the sources of uncertainty about DU transport.

24760 (LA-SUB–93-169) **Survey for bats in the Los Alamos National Environmental Research Park, with special emphasis on the spotted bat, Euderma maculatum.** Tyrell, K.; Brack, V. Jr. Los Alamos National Lab., NM (United States); 3D/Environmental Services, Inc., Cincinnati, OH (United States). 29 Oct 1992. 56p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. Order Number DE93012081. Source: OSTI; NTIS; GPO Dep.

To increase knowledge about the presence of endangered species and their habitat at the LANL, 3D/Environmental Services, Inc. conducted a mist net survey for bats on Laboratory lands. In addition to documenting the presence of threatened and endangered species, this survey was conducted to gain more knowledge about the diversity and distribution of the bat fauna existing on the Laboratory. There are 25 species of bats found in New Mexico, about 16 of which are likely to occur in the region of the Laboratory. Of particular interest was documentation of the presence of the spotted bat, Euderma maculatum. The spotted bat is listed as Endangered, Group 2 by the State of New Mexico, and is a Federal Candidate for listing as endangered. As such, conservation of this species and its habitat should be a management priority on the Laboratory. A total of 94 bats were captured in 16 net nights, between 30 June and 05 July 1992. Thirteen species of bats were caught during the study: Antrozous pallidus (pallid bat), 10.6 percent; Eptesicus fuscus (big brown bat), 10.6 percent; Lasionycteris noctivigans (silver-haired bat), 16 percent; Lasiurus cinereus (hoary bat), 11.7 percent; Myotis californicus (California myotis), 4.3 percent; M. evotis (long-eared myotis), 7.4 percent; M. leibii (small-footed myotis), 5.3 percent; M. thysanodes (fringed myotis), 13.8 percent; M. volans (long-legged myotis), 7.4 percent of the catch; M. yumanensis,(Yuma myotis), 5.3 percent; Pipistrellus hesperus (western pipistrelle), 1.1 percent; Plecotus townsendii (Townsend's big-eared bat), 1.1 percent, and Tadarida brasiliensis (Brazilian free-tailed bat), 5.3 percent.

24761 (LA-UR–93-484) **Depleted uranium risk assessment at Aberdeen Proving Ground.** Ebinger, M.H. (Los Alamos National Lab., NM (United States)); Myers, O.B.; Kennedy, P.L.; Clements, W.H. Los Alamos National Lab., NM (United States). [1993]. 10p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9303112–1: American Defense Preparedness Associates symposium on the environment, Albuquerque, NM (United States), 23-25 Mar 1993). Order Number DE93008705. Source: OSTI; NTIS; INIS; GPO Dep.

The Environmental Science Group at Los Alamos and the Test and Evaluation Command (TECOM) are assessing the risk of depleted uranium (DU) testing at Aberdeen Proving Ground (APG). Conceptual and mathematical models of DU transfer through the APG ecosystem have been developed in order to show the mechanisms by which DU migrates or remains unavailable to different flora and fauna and to humans. The models incorporate actual rates of DU transfer between different ecosystem components as much as possible. Availability of data on DU transport through different pathways is scarce and constrains some of the transfer rates that can be used. Estimates of transfer rates were derived from literature sources and used in the mass-transfer models when actual transfer rates were unavailable. Objectives for this risk assessment are (1) to assess if DU transports away from impact areas; (2) to estimate how much, if any, DU migrates into Chesapeake Bay; (3) to determine if there are appreciable risks to the ecosystems due to DU testing; (4) to estimate the risk to human health as a result of DU testing.

24762 (LA-UR–93-1200) **Manipulating remotely-sensed data with Khoros.** Kelly, P.M.; White, J.M. Los Alamos National Lab., NM (United States). [1993]. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9305168–2: Application Visualization System (AVS) '93 users group meeting, Orlando, FL (United States), 24-26 May 1993). Order Number DE93012622. Source: OSTI; NTIS; GPO Dep.

Satellite image analysis typically requires the handling of very large data sets, and the amount of data which will be available from satellite sensors in the future is immense. In this paper, the authors describe two particular remote-sensing applications which they have approached using the Khoros system. The first application discussed is the clustering of large multispectral data sets for efficient analysis and classification. The second application is the automatic identification of urban areas using texture measures and various pattern recognition routines. They have installed a number of new routines into the Khoros environment for working on these projects.

24763 (MLM–3517) **The Mound site survey project for the characterization of radioactive materials in site soils.** Stought, R.L.; Edling, D.A.; Draper, D.G. Mound, Miamisburg, OH (United States). 16 May 1988. 181p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-88DP43495. Order Number DE93011021. Source: OSTI; NTIS; INIS; GPO Dep.

This report summarizes the results of a site survey project conducted at Monsanto Research Corporation's Mound Facility during 1982–1985. The objectives of the site survey were: To characterize the nineteen sites previously identified as having known levels of contamination; to identify and characterize by quantity and type of radionuclide(s) any additional major sites having levels of contamination exceeding 10 pCi/g (for Pu-238) of soil; to estimate the volume of contaminated soil; and to estimate the cost of stabilizing or removing the contaminated soil. This report provides information on objectives 1 and 2 above. A separate report will address objectives 3 and 4.

24764 (ORNL/ER–138) **Surface radiological investigations at environmental research area 11, ^{137}Cs- and ^{60}Co-contaminated plots at Oak Ridge National Laboratory, Oak Ridge, Tennessee: Environmental Restoration Program.** Uziel, M.S.; Tiner, P.F.; Williams, J.K. Oak Ridge National Lab., TN (United States). Feb 1993. 42p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93010256. Source: OSTI; NTIS; INIS; GPO Dep.

A surface radiological investigation at the ^{137}Cs- and ^{60}Co-contaminated forest area (Chestnut Ridge east and west plots) was conducted from January 1992 through August 1992. Results of the survey revealed numerous spots and small areas of surface contamination that followed the original placement of feeders used for ^{60}Co- and ^{137}Cs-labeled seeds in a 1969–1970 study. Surface gamma exposure rates reached 380 μR/h at the east plot and 400 μR/h at the west plot, but approximately one-half and one- third, respectively, of the identified anomalies did not exceed 39 μR/h. Results of soil sample analyses demonstrated that ^{137}Cs and ^{60}Co were responsible for the elevated radiation levels. Radionuclides were found below the surface at soil sample locations, in some cases at depths below 18 in. The same pattern of subsurface contamination may be present at other elevated surface spots at both plots. These survey results show that current radiological conditions at the site remain an environmental problem. Recommendations for corrective actions are included.

24765 (ORNL/FTR–4194) **Travel to Karlsruhe, Germany to exchange information on the in situ destruction of volatile organic compounds: Foreign trip report, February 10–16, 1992.** Siegrist, R.L. Oak Ridge National Lab., TN (United States). 16 Mar 1992. 18p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93011104. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The objective of the detailed trip was to meet with researchers at the University of Karlsruhe and their private industry partners to discuss and to exchange information on the in situ destruction of volatile organic compounds and to refine a project plan for the DOE International Technology Exchange Program (ITEP).

24766 (ORNL/FTR–4208) **The initiation of an environmental restoration project incorporating the bidirectional (US-Germany) transfer of environmental management technologies: Foreign trip report, February 23–29, 1992.** Faison, B.D. Oak Ridge National Lab., TN (United States). 16 Mar 1992. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93011105. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The traveler attended meetings at Rossendorf to formalize a cooperative agreement with Ogden Environmental and Energy Services, Inc. (a US company) aimed at the restoration of sites contaminated by uranium milling activities near Crossen. Technologies developed at ORNL to be implemented in the restoration were described, with emphasis on biosorption for removal of dissolved uranium from tailings ponds. The goals of the International Technology Exchange Program, which funds ORNL's participation, and MMES were explained. Organizational ties were established with WISMUT and STEAG, the site operators. German technologies relevant to the uranium fuel cycle and/or the restoration of US sites were reviewed. Cooperation with three German national laboratories – Rossendorf (ZFK), Karlsruhe (KFK), and Leipzig-Halle (UFZ)– was initiated. A meeting was held at the demonstration site at Crossen to exchange technical data, followed by a tour of the site.

24767 (ORNL/FTR–4258) **Travel to Sweden, Denmark, and Norway to and participate in the international symposium on experimental manipulations of biota and biogeochemical cycling in ecosystems: Foreign trip report, May 16–24, 1992.** Turner, R.S. Oak Ridge National Lab., TN (United States). 3 Jun 1992. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93011081. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The traveler presented a paper "A Large-Scale Throughfall Manipulation Experiment on Walker Branch Watershed" at the International Symposium on Experimental Manipulations of Biota and Biogeochemical Cycling in Ecosystems. The workshop-format meeting was sponsored by the Directorate-General for Science, Research, and Development of the Commission of the European Communities. The aim of the symposium was to present and review the major ongoing studies of manipulations of ecosystems in Europe and around the world.

24768 (ORNL/FTR–4397) **[Travel to Finland for a review of the carbon balance of peatlands and climate change project]: Foreign trip report, September 26, 1992–October 3, 1992.** Trettin, C.C. Oak Ridge National Lab., TN (United States). 19 Oct 1992. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93012120. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This is a trip report by an ORNL researcher. The purpose of the trip was to participate in a review of the Carbon Balance of Peatlands and Climate Change Project, which is a component of the Finnish National Program on Climate Change.

24769 (ORNL/FTR–4441) **[International Geosphere-Biosphere Program workshop on global soils data]: Foreign trip report, October 5–10, 1992.** Emanuel, W.R. Oak Ridge National Lab., TN (United States). 26 Oct 1992. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93009929. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Soils are an important component of the climate system and global biogeochemical cycles and affect the responses of these systems to fossil fuel use and other human activities. I traveled to England to participate in a workshop, organized by the Data and Information System of the International Geosphere-Biosphere Program, to develop plans for a global soils data base for modeling and analysis of the earth systems involved in global environmental change. The workshop identified data needs and availability and prepared a plan for a pilot data project that will be implemented in about one year. I also visited the Rothamsted Experimental Station to review long-term data on dead organic matter and models of

dead organic matter turnover that can be incorporated into global carbon cycle models for analyzing changes in atmospheric CO_2.

24770 (ORNL/FTR–4562) **[Workshops concerning environmental carbon dioxide and terrestrial carbon]: Foreign trip report, February 27–March 6, 1993.** Wright, L.L.; Luxmoore, R.J. Oak Ridge National Lab., TN (United States). 1 Apr 1993. 20p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93011817. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The travelers each presented an invited paper at the workshop, peer reviewed several manuscripts that were provided by participants, and participated in two of eight work groups. The work groups and the invited presentations were focused on global terrestrial ecosystems from tundra to tropical, as well as potential approaches for mitigating rising atmospheric carbon dioxide through agricultural and forestry practices. The workshop efforts were broad ranging and included policy implications of the scientific findings. Summaries of selected presentations of particular interest are provided along with an outline of the scientific synthesis findings and policy implications from the eight work groups. The prepared papers from participants and synthesis reports will be published in a special issue of the journal Water, Air and Soil Pollution. These proceedings will be of value to the US Department of Energy programs in Carbon Dioxide Research and Biofuels Systems. The findings from the workshop will be offered to the InterGovernmentalPanel on Climate Change.

24771 (ORNL/M–1759) **Environmental surveillance data report for the third quarter of 1992.** Goldberg, P.Y.; Cooper, R.C.; Hamilton, L.V.; Hughes, J.F.; Horwedel, B.M.; Loffman, R.S.; Salmons, M.C.; Stevens, M.M.; Valentine, C.K. Oak Ridge National Lab., TN (United States). Feb 1993. 139p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93008984. Source: OSTI; NTIS; GPO Dep.

The Environmental Surveillance and Protection Section within the Office of Environmental Compliance and Documentation at the Oak Ridge National Laboratory (ORNL) is responsible for the development and implementation of an environmental program to (1) ensure compliance with all federal, state, and Department of Energy (DOE) reporting requirements to quantitatively demonstrate prevention, control, and abatement of environmental pollution; (2) monitor the adequacy of containment and effluent controls; and (3) assess impacts of releases from ORNL facilities on the environment. Environmental monitoring, as defined by the Regulatory Guide, consists of two major activities: effluent monitoring and environmental surveillance. Effluent monitoring is the collection and analysis of samples or measurements of liquid and gaseous effluents. Monthly or quarterly summaries are presented in this report for each medium sampled.

24772 (ORNL/RASA–92/14) **Results of the radiological survey at the former Alba Craft Laboratory site properties, Oxford, Ohio (OXO001).** Murray, M.E.; Brown, K.S.; Mathis, R.A. Oak Ridge National Lab., TN (United States). Mar 1993. 38p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93010257. Source: OSTI; NTIS; INIS; GPO Dep.

At the request of the US Department of Energy (DOE), a team from Oak Ridge National Laboratory conducted a radiological survey at the former Alba Craft Laboratory Site Properties, Oxford, Ohio. The survey was performed in July and September of 1992. The purpose of the survey was to determine whether the property was contaminated with radioactive residues, primarily ^{238}U, from uranium machining operations conducted for National Lead of Ohio, a prime Atomic Energy Commission contractor. The survey included scan measurement of direct radiation levels inside and outside the former laboratory, outdoors on eight properties adjoining the former laboratory, and the city right-of-way adjacent to the surveyed properties. Radionuclide concentrations were determined in outdoor surface and subsurface soil samples taken from each property and the exterior of the laboratory. Fixed surface residual radioactivity was measured inside the laboratory and outside the building. Air samples were collected, direct exposure was measured, and samples were collected to measure transferable radioactivity inside the building. Results of the survey indicate areas where surface and soil contamination level s are above the DOE guidelines for uncontrolled areas.

24773 (ORNL/TM–12226) **Potential effect of natural gas wells on alluvial groundwater contamination at the Kansas City Plant.** Pickering, D.A. (Oak Ridge National Lab., TN (United States)); Laase, A.D.; Locke, D.A. Oak Ridge National Lab., TN (United States). May 1993. 128p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93013455. Source: OSTI; NTIS; INIS; GPO Dep.

This report is the result of a request for further information about several abandoned natural gas wells at the US Department of Energy's Kansas City Plant (KCP). The request was prompted by an old map showing several, possibly eight, natural gas wells located under or near what is now the southeast corner of the Main Manufacturing Building at KCP. Volatile organic compound contamination in the alluvial aquifer surrounding the gas wells might possibly contaminate the bedrock aquifer if the gas wells still exist as conduits. Several circumstances exist that make it doubtful that contamination is entering the bedrock aquifers: (1) because regional groundwater flow in the bedrock beneath the KCP is expected to be vertically upward, contaminants found in the alluvial aquifer should not migrate down the old wells; (2) because of the low hydraulic conductivity of the bedrock units, contaminant transport would be extremely slow if the contaminants were migrating down the wells; and (3) casing, apparently set through the alluvium in all of the wells, would have deteriorated and may have collapsed; if the casing collapsed, the silty clays in the alluvium would also collapse and seal the well. No definitive information has been discovered about the exact location of the wells. No further search for or consideration of the old gas wells is recommended.

24774 (PNL–8485) **Savage Island Project borehole completion report.** Chamness, M.A.; Gilmore, T.J.; Teel, S.S. Pacific Northwest Lab., Richland, WA (United States). Feb 1993. 347p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93009083. Source: OSTI; NTIS; INIS; GPO Dep.

Most of the report is handwritten manuscript.

This report discusses three wells which were drilled in 1990 and 1991 in support of Pacific Northwest Laboratory's Ground-Water surveillance Project. These wells were intended to monitor the Rattlesnake Ridge interbed aquifer and the deeper portion of the unconfined aquifer to determine whether ground-water contamination emanating from the Hanford Site was migrating offsite through these aquifers. This report discusses well construction, lithologies encountered, and other data collected during drilling. At least three reports have been or are being prepared to discuss the results of this well monitoring project.

24775 (PNL–8506) **Arid Lands Ecology Facility management plan.** Pacific Northwest Lab., Richland, WA (United States). Feb 1993. 48p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93008628. Source: OSTI; NTIS; GPO Dep.

The Arid Lands Ecology (ALE) facility is a 312-sq-km tract of land that lies on the western side of the Hanford Site in southcentral Washington. The US Atomic Energy Commission officially set aside this land area in 1967 to preserve shrub-steppe habitat and vegetation. The ALE facility is managed by Pacific Northwest Laboratory (PNL) for the US Department of Energy (DOE) for ecological research and education purposes. In 1971, the ALE facility was designated the Rattlesnake Hills Research Natural Area (RNA) as a result of an interagency federal cooperative agreement, and remains the largest RNA in Washington. it is also one of the few remaining large tracts of shrub-steppe vegetation in the state retaining a predominant preeuropean settlement character. This management plan provides policy and implementation methods for management of the ALE facilities consistent with both US Department of Energy Headquarters and the Richland Field Office decision (US Congress 1977) to designate and manage ALE lands as an RNA and as a component of the DOE National Environmental Research Park System.

24776 (PNL–8532) **Environmental surveillance master sampling schedule.** Bisping, L.E. Pacific Northwest Lab., Richland,

WA (United States). Jan 1993. 78p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93008626. Source: OSTI; NTIS; GPO Dep.

Environmental surveillance of the Hanford Site and surrounding areas is conducted by the Pacific Northwest Laboratory (PNL) for the US Department of Energy (DOE). Samples are routinely collected and analyzed to determine the quality of air, surface water, ground water, soil, sediment, wildlife, vegetation, foodstuffs, and farm products at Hanford Site and surrounding communities. This document contains the planned schedule for routine sample collection for the Surface Environmental Surveillance Project (SESP) and Drinking Water Project, and Ground-Water Surveillance Project.

24777 (PNL-SA–20740) **Engineering scaleup of electrical soil heating for soil decontamination.** Heath, W.O.; Roberts, J.S.; Lessor, D.E.; Bergsman, T.M. Pacific Northwest Lab., Richland, WA (United States). Aug 1992. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-920851–86: Spectrum '92: nuclear and hazardous waste management international topical meeting, Boise, ID (United States), 23-27 Aug 1992). Order Number DE93007870. Source: OSTI; NTIS; GPO Dep.

The objective of PNL's efforts in electrically based methods for environmental restoration is to provide new and cost-effective means for removing hazardous organic contaminants from soils, and to detoxify those contaminants after they are removed. Recent work has concentrated on two areas: electrical soil heating to remove volatile and semivolatile compounds from soils, and in situ oxidation via a form of low-temperature plasma to decompose nonvolatile and bound contaminants. This paper covers only the electrical soil heating component, and describes recent efforts to model the heating process to enable equipment and energy requirements to be specified. An initial field test of the heating process suggests that the model presented in this paper is correct, within the range of uncertainty in the spatial variations of soil properties. Because of page limitations, a description of this test and discussion of the test results will be relegated to a subsequent publication.

24778 (PNL-SA–20853) **The In Situ Vitrification Integrated Program: Focusing an innovative solution on environmental restoration needs.** Buelt, J.L.; Thompson, L.E. Pacific Northwest Lab., Richland, WA (United States). Aug 1992. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-920851–88: Spectrum '92: nuclear and hazardous waste management international topical meeting, Boise, ID (United States), 23-27 Aug 1992). Order Number DE93008915. Source: OSTI; NTIS; GPO Dep.

The objective of the In Situ Vitrification (ISV) Integrated Program is to ensure that ISV is a viable alternative for DOE environmental restoration applications. The program focuses ISV development activities upon DOE-wide environmental remediation needs and resolves issues inhibiting timely implementation on DOE sites. currently the ISV Integrated Program is focused on contaminated soil sites but is also resolving some key issues that are common to soils and to potential future applications such as buried waste and underground structures. This paper describes the status and current focus of the ISV Integrated Program.

24779 (PNL-SA–20985) **Poster session: Integrated demonstration for remediation of volatile organic compounds at arid sites.** Stein, S.L. (Pacific Northwest Lab., Seattle, WA (United States)). Pacific Northwest Lab., Richland, WA (United States). Aug 1992. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-920851–89: Spectrum '92: nuclear and hazardous waste management international topical meeting, Boise, ID (United States), 23-27 Aug 1992). Order Number DE93008990. Source: OSTI; NTIS; GPO Dep.

The Integrated Demonstration for Cleanup of Volatile Organic Compounds (VOC-Arid ID) was initiated by the US Department of Energy (DOE) to accelerate the process for developing, evaluating, and deploying technology for cleaning up VOCs and other hazardous constituents in and environments. Over the next few years, the ID will focus on technologies for characterization and monitoring through treatment and closure. This paper describes the problem that is being addressed by the VOC-Arid ID, the host site, interaction with the end users of the ID's technologies, specific technologies that make up the ID, links with industry, and the ID's schedule.

24780 (PNL-SA–21537) **Field test of Six-Phase Soil Heating and evaluation of engineering design code.** Bergsman, T.M.; Roberts, J.S.; Lessor, D.L.; Heath, W.O. Pacific Northwest Lab., Richland, WA (United States). Feb 1993. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-930205–34: Waste management '93, Tucson, AZ (United States), 28 Feb - 4 mar 1993). Order Number DE93009477. Source: OSTI; NTIS; INIS; GPO Dep.

A field test was conducted to evaluate the performance of Six-Phase Soil Heating to enhance the removal of contaminants. The purpose of the test was to determine the scale-up characteristics of the Six-Phase Soil Heating technology and to evaluate a computer process simulator developed for the technology. The test heated a 20-ft diameter cylinder of uncontaminated soil to a 10-ft depth. Six-phase ac power was applied at a rate of 30–35 kW using a power system built from surplus electrical components. The test ran unattended, using a computer-based system to record data, alert staff of any excursions in operating conditions via telephone, and provide automatic shut-off of power depending on the type of excursion. The test data included in situ soil temperatures, voltage profiles, and moisture profiles (using a neutron-probetechnique). After 50 days of heating, soil in the center of the array at the 6-ft depth reached 80°C. Soil temperatures between the two electrodes at this depth reached approximately 75°C. Data from this test were compared with those predicted by a computer process simulator. The computer process simulator is a modified version of the TOUGH2 code, a thermal porous media code that can be used to determine the movement of air and moisture in soils. The code was modified to include electrical resistive heating and configured such that an application could be run quickly on a workstation (approximately 5 min for 1 day of field operation). Temperature and soil resistance data predicted from the process simulations matched actual data fairly closely. A series of parametric studies was performed to assess the affect of simulation assumptions on predicted parameters.

24781 (PNL-SA–21710) **Tunable hybrid plasma decomposition of dilute concentrations of CC14 in air.** Truex, M.J. (Pacific Northwest Lab., Richland, WA (United States)); Bromberg, L.; Cohn, D.R.; Koch, M.; Patrick, R.M.; Thomas, P. Pacific Northwest Lab., Richland, WA (United States). Jan 1993. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-930160–7: 2. semi-annual Office of Technology Development (OTD) information meeting, Houston, TX (United States), 26-28 Jan 1993). Order Number DE93007993. Source: OSTI; NTIS; GPO Dep.

At the Department of Energy Hanford site, a large quantity of the industrial solvent carbon tetrachloride (CC14) was used and subsequently disposed of in leaching fields. Efforts under the Volatile Organic Compound - Arid Integrated Demonstration Program (VOC-Arid ID) are directed at vapor extraction of carbon tetrachloride from the ground and its subsequent decomposition in the contaminated humid air stream. We are developing a mobile electron-beam driven plasma reactor for versatile efficient on-site decomposition of CC14 and other VOCs in carrier gases at atmospheric pressure. The decomposition of the VOCs could result in the generation of CO_2, light hydrocarbons, and reactive chlorine compounds. The latter dissolve and/or dissociate in aqueous solutions.

24782 (PNL-SA–21865) **Implementing and operating the Hanford Environmental Information System and applying it to the carbon tetrachloride expedited response action.** Cowley, P.J. (Pacific Northwest Lab., Richland, WA (United States)); Last, G.V.; Schwab, M.R.; Rohay, V.J. Pacific Northwest Lab., Richland, WA (United States). Feb 1993. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-930205–45: Waste management '93, Tucson, AZ (United States), 28 Feb - 4 mar 1993). Order Number DE93009810. Source: OSTI; NTIS; INIS; GPO Dep.

To manage waste and perform environmental monitoring and restoration at the 1450-square kilometer (560-square mile) Hanford Site in southeastern Washington State, vast amounts of scientific

and technical data are being generated from sampling. This paper provides an overview of the Hanford Environmental Information System (HEIS), a computerized system designed and implemented to manage the Site's environmental sampling data, lessons learned from putting HEIS into operation, and how HEIS is being applied to the carbon tetrachloride expedited response action being performed at the Site.

24783 (PNL-SA–22251) **Environmental restoration using plant-microbe bioaugmentation.** Kingsley, M.T.; Fredrickson, J.K.; Metting, F.B.; Seidler, R.J. Pacific Northwest Lab., Richland, WA (United States). Apr 1993. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-930482–6: 2. international symposium in situ and on-site bioreclamation, San Diego, CA (United States), 5-8 Apr 1993). Order Number DE93013160. Source: OSTI; NTIS; INIS; GPO Dep.

Land farming, for the purpose of bioremediation, refers traditionally to the spreading of contaminated soil, sediments, or other material over land; mechanically mixing it; incorporating various amendments, such as fertilizer or mulch; and sometimes inoculating with degradative microorganisms. Populations of bacteria added to soils often decline rapidly and become metabolically inactive. To efficiently degrade contaminants, microorganisms must be metabolically active. Thus, a significant obstacle to the successful use of microorganisms for environmental applications is their long-term survival and the expression of their degradative genes in situ. Rhizosphere microorganisms are known to be more metabolically active than those in bulk soil, because they obtain carbon and energy from root exudates and decaying root matter. Rhizosphere populations are also more abundant, often containing 10^8 or more culturable bacteria per gram of soil, and bacterial populations on the rhizoplane can exceed 10^9/g root. Many of the critical parameters that influence the competitive ability of rhizosphere bacteria have not been identified, but microorganisms have frequently been introduced into soil (bioaugmentation) as part of routine or novel agronomic practices. However, the use of rhizosphere bacteria and their in situ stimulation by plant roots for degrading organic contaminants has received little attention. Published studies have demonstrated the feasibility of using rhizobacteria (Pseudomonas putida) for the rapid removal of chlorinated pesticides from contaminated soil, and to promote germination of radish seeds in the presence of otherwise phytotoxic levels of the herbicide 2,4-dichlorophenoxyacetic acid (2,4-D), and phenoxyacetic acid (PAA). The present investigation was undertaken to determine if these strains (Pseudomonas putida PPO301/pRO101 and PPO301/pRO103) could be used to bioremediate 2,4-D-amended soil via plant-microbe bioaugmentation.

24784 (POEF/ER/Sub–88/4551/D1-Vol.3) **Quadrant III RFI draft report: Appendix B-I, Volume 3.** Portsmouth Gaseous Diffusion Plant, OH (United States); Geraghty and Miller, Inc., Dublin, OH (United States). Environmental Services. Dec 1992. 705p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-76OR00001. Order Number DE93007780. Source: OSTI; NTIS; INIS; GPO Dep.

In order to determine the nature and extent of contamination at a RCRA site it is often necessary to investigate and characterize the chemical composition of the medium in question that represents background conditions. Background is defined as current conditions present at a site which are unaffected by past treatment, storage, or disposal of hazardous waste (OEPA, 1991). The background composition of soils at the Portsmouth Gaseous Diffusion Plant (PORTS) site was characterized for the purpose of comparing investigative soil data to a background standard for each metal on the Target Compound List/Target Analyte List and each radiological parameter of concern in this RFI. Characterization of background compositions with respect to organic parameters was not performed because the organic parameters in the TCL/TAL are not naturally occurring at the site and because the site is not located in a highly industrialized area nor downgradient from another unrelated hazardous waste site. Characterization of the background soil composition with respect to metals and radiological parameters was performed by collecting and analyzing soil boring and hand-auger samples in areas deemed unaffected by past treatment, storage, or disposal of hazardous waste. Criteria used in determining whether a soil sample location would be representative of the true background condition included: environmental history of the location, relation to Solid Waste Management Units (SWMU's), prevailing wind direction, surface runoff direction, and ground-water flow direction.

24785 (POEF/ER/Sub–88/4551/D1-Vol.4) **Quadrant III RFI draft report: Appendix J, Baseline risk assessment: Volume 4.** Portsmouth Gaseous Diffusion Plant, OH (United States); Geraghty and Miller, Inc., Dublin, OH (United States). Environmental Services. Dec 1992. 937p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-76OR00001. Order Number DE93007781. Source: OSTI; NTIS; INIS; GPO Dep.

In accordance with the Risk Assessment Guidance for Superfund (U. S.EPA 1989), which states that background risk should be calculated separately from site-related risk in order to provide important information to the risk manager, this appendix assesses the human health risks associated with background levels of naturally occurring compounds in soil at the Portsmouth Gaseous Diffusion Plant (PORTS). This appendix is organized as follows: Background Conditions, in which the results of Geraghty & Miller's work on characterizing background levels of naturally occurring compounds in soils is summarized; Identification of Exposure Pathways; Estimation of Environmental Concentrations; Estimation of Human Intake; Toxicity Assessment, and Risk Characterization, in which numerical estimates of carcinogenic and noncarcinogenic risk are calculated for each naturally occurring compound and potential exposure pathway.

24786 (UBA-FB–92-104) **Heavy metals and other pollutants in fertilizers. Literature evaluation and analyses.** Umweltbundesamt - Texte. Boysen, P. Landwirtschaftskammer Schleswig-Holstein, Kiel (Germany). Landwirtschaftliche Untersuchungs- und Forschungsanstalt (LUFA); Umweltbundesamt, Berlin (Germany). Dec 1992. 106p. (In German). Contract UFOPLAN 10701016/01. Order Number DE93795277. Source: OSTI; NTIS (US Sales Only).

As part of the research and development project, two papers were prepared on heavy metals in fertilizers and on organic pollutants in fertilizers. In addition, about 10.000 fertilizer analyses were carried out for heavy metals and other anorganic pollutants. The details from the bibliography and the new analyses produced only partial agreement. When evaluating the results, the pollutant contents are displayed according to the types of fertilizer. From the total fertilizer consumption and the pollutant contents, it was possible to compute the average pollutant load. In addition, balance sheets were drawn up for special agricultural or gardening usage and fertilizer systems. (orig.) With 13 refs., 30 tabs.

24787 (UCID–21536-Add.2) **Logs of wells and boreholes drilled during hydrogeologic studies at Lawrence Livermore National Laboratory Site 300, January 1, 1991–September 1, 1992: Addendum 2.** Crow, N.B. (Lawrence Livermore National Lab., CA (United States)); McConihe, W.L. Lawrence Livermore National Lab., CA (United States). 1992. 440p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE93008622. Source: OSTI; NTIS; INIS; GPO Dep.

Lawrence Livermore National Laboratory (LLNL) Site 300 is located in the Altamont Hills between Livermore and Tracy, about 18 road miles southeast of Livermore, California. The site is used as a test facility to support national defense research carried out by LLNL. This Addendum 2 to the Logs of Wells and Boreholes Drilled During Hydrogeologic Studies at Lawrence Livermore National Laboratory Site 300 presents hydrogeologic logs for monitor wells and boreholes drilled primarily between January 1, 1991 and September 1, 1992. Some logs drilled earlier and not incorporated in earlier volumes of this document are also included here. A small number of logs drilled before September 1, 1992, are not available at the time of closing the report for publication of this volume (Addendum 2), but will be included in subsequent documents. By September 1, 1992, a total of 495 monitor wells and 285 exploratory boreholes had been drilled at Site 300 since the beginning of hydrogeologic studies in 1982. The primary purpose of these logs is to document lithologic and hydrogeologic conditions together with well completion information. For this reason, not all

chemical analytical data are presented. These logs report concentrations of only the most commonly encountered volatile organic compounds, trace metals, and radionuclides detected in ground water and soil samples collected during drilling.

24788 (UCRL-ID–108524) **Gamma-ray and surface organic results of the robotic survey of Pit 9 at INEL: Technical evaluations report for work done at the raiological waste management complex at the Idaho National Engineering Laboratory, Summer, 1991.** Clegg, B. (Science Applications International Corp., Pleasanton, CA (United States)); Rowland, M.; Pence, J. Lawrence Livermore National Lab., CA (United States). Sep 1991. 28p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE93013103. Source: OSTI; NTIS; INIS; GPO Dep.

The Buried Waste Robotics Program demonstrated and evaluated robotic techniques to non-invasively characterize a representative radiological burial area at the Idaho National Engineering Laboratory (ML). Lawrence Livermore National Laboratory (LLNL) contributed a large, NaI gamma-ray detector system and a photoionization organics detector to this program. This Program mounted multiple geophysics, nucleonic, and chemical sensor systems on the Solder Robot Interface Program (SRIP) remotely operated vehicle. These sensors simultaneously collected radiological waste-site, surface characterization data on Pit 9 radiological burial area, and the Cold Test Pit (CTP), off-site control area. LLNL sensors found no radiological waste at the CTP control area, however, we easily detected the natural thorium series, the potassium radionuclides and trace worldwide fallout cesium. Earlier manual measurements indicated no significant data error invoked by the vehicle on our gamma-ray and organic sensor systems. Thick soil overburden at the Subsurface Disposal Area (SDA), Pit 9, permitted radiological, but no isotopic determinations. A flood of scattered photons from the buried waste allows a surface, spatial radiological dose assessment. We found no evidence of surface-evolving organics, sensitive to photo-ionization detection. The observed signals can safely guide a remediation excavation. The vehicle-supported multiple measurements enhanced the data collection efficiency. Data provided site-surface characterization, quickly and safely in potentially hazardous areas. However, a large, buried-waste site will require subsurface access for detailed characterization.

24789 (UCRL-ID–111013) **Underground radionuclide migration at the Nevada Test Site.** Nimz, G.J. (Lawrence Livermore National Lab., CA (United States)); Thompson, J.L. Lawrence Livermore National Lab., CA (United States). 22 Jun 1992. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE93009450. Source: OSTI; NTIS; INIS; GPO Dep.

This document reviews results from a number of studies concerning underground migration of radionuclides from nuclear test cavities at the Nevada Test Site (NTS). Discussed are all cases known to the Department of Energy's Hydrology and Radionuclide Migration Program where radionuclides have been detected outside of the immediate vicinity of nuclear test cavities that are identifiable as the-source of the nuclides, as well as cases where radionuclides might have been expected and were intentionally sought but not fixed. There are nine locations where source-identifiable radionuclide migration has been detected, one where migration was purposely induced by pumping, and three where migration might be expected but was not found. In five of the nine cases of non-induced migration, the inferred migration mechanism is prompt fracture injection during detonation. In the other four cases, the inferred migration mechanism is water movement. In only a few of the reviewed cases can the actual migration mechanism be stated with confidence, and the attempt has been made to indicate the level of confidence for each case. References are cited where more information may be obtained. As an aid to future study, this document concludes with a brief discussion of the aspects of radionuclide migration that, as the present review indicates, are not yet understood. A course of action is suggested that would produce a better understanding of the phenomenon of radionuclide migration.

24790 (UCRL-JC–106541) **Treatment of ground water contaminated with volatile organic compounds using second generation ultraviolet light technology.** Lyandres, S.E. (Amrutech, Inc., Berkeley, CA (United States)); Rees, J.T.; Folsom, E.N.; Boegel, A.J. Lawrence Livermore National Lab., CA (United States). Mar 1991. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9104215–3: HAZMACON '91, Santa Clara, CA (United States), 16-18 Apr 1991). Order Number DE93010508. Source: OSTI; NTIS; INIS; GPO Dep.

Pilot tests, using a second generation ultraviolet (UV) light technology, were run on ground water samples taken f rom two separate aquifers contaminated with volatile organic compounds (VOCS) at the Lawrence Livermore National Laboratory (LLNL) in Alameda County, California. The VOCs included gasoline, TCE, and 1,2-DCA. VOC concentrations in the ground water ranged from 11 to 1,000 ppB. Discharges of treated ground water at LLNL are not to exceed 5 ppb total VOCs under a Federal National Pollution Discharge Elimination System discharge permit. Test results indicated that double-bonded VOCS, including aromatic compounds and TCE, were decomposed quickly and efficiently to low or non-detectable levels (<0.5 ppB, analyzed with a gas chromatograph). An equivalent level of degradation for 1,2-DCA required a moderately higher UV energy input and greater concentrations of additives. Concentrations of peroxide tested ranged between 10 and 60 ppM; however, those above 30 ppM did not significantly increase the rate of VOC destruction.

24791 (UCRL-JC–109508) **An evaluation of a teleoperated waste-site survey technique.** Rowland, M. (Lawrence Livermore National Lab., CA (United States)); Pence, J.; Clegg, B. Lawrence Livermore National Lab., CA (United States); Science Applications International Corp., Pleasanton, CA (United States). 22 Jun 1992. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-920606–45: American Nuclear Society annual meeting, Boston, MA (United States), 7-12 Jun 1992). Order Number DE93012582. Source: OSTI; NTIS; INIS; GPO Dep.

The efficacy of teleoperated gamma-ray and vapor sensors was tested for the timely, non-invasive characterization of buried radiological waste before its removal. Conventional nucleonics and chlorinated vapor sensors were adapted for a teleoperated vehicle that functioned as a remote sensor and a characterization system. Radiological and chemical data were collected at the Idaho National Engineering Laboratory (INEL) on the Radioactive Waste Management Complex (RWMC) and we found that the method fell short on specific characterization. Soil overburden accounts for this shortfall as this overburden intentionally shields hazards as well as needed detailed characterization data. A simple, gamma-transport calculation based on our RWMC data indicates that the remaining sensor signatures are sufficient to supply radiosource size and isotope types during site remediation.

24792 (UCRL-JC–110055) **Monitoring remediation of trichloroethylene using a chemical fiber optic sensor: Field studies.** Colston, B. Jr.; Brown, S.B.; Langry, K.; Daley, P.; Milanovich, F.P. Lawrence Livermore National Lab., CA (United States). May 1992. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-920851–90: Spectrum '92: nuclear and hazardous waste management international topical meeting, Boise, ID (United States), 23-27 Aug 1992). Order Number DE93009284. Source: OSTI; NTIS; INIS; GPO Dep.

Field tests of a remote fiber optic chemical sensor have recently been completed. The sensor has measured trace quantities of organohalides in the vadose zone and groundwater. Due to its toxicological importance and accessibility, a specific contaminant monitored was trichloroethylene (TCE). Two elements considered in these field measurements included temperature and carbon dioxide (CO_2) fluctuations. The effects of these properties on the sensor have been modeled in the lab. These results were used in the final determination of TCE concentration. Department of Energy (DOE) sites where remediation work is in progress provided opportunities for testing the sensor. One test was conducted in the vadose zone over sampling wells at the Savannah River Plant DOE integrated test site. Measurements were made before and several months after remediation procedures were in progress. A

series of wells was selected with discretely screened depth intervals. Data were collected over a range of depths. A second set of experiments took place at Lawrence Livermore Site 300, in collaboration with a private company (Purus). Purus is remediating groundwater contaminated with halogenated volatile organic compounds. The sensor was set up to continuously monitor the processed gas stream. Supporting data were provided in this case with side by side gas chromatograph measurements.

24793 (UCRL-JC–110235) **Enhancing aquifer cleanup with reinjection.** Isherwood, W.F. (Lawrence Livermore National Lab., CA (United States)); Ziagos, J.; Rice, D. Jr.; Krauter, P.; Nichols, E. Lawrence Livermore National Lab., CA (United States). Sep 1992. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9211208–1: National Ground Water Association (NGWA) meeting, Houston, TX (United States), 4-6 Nov 1992). Order Number DE93009249. Source: OSTI; NTIS; INIS; GPO Dep.

Injection of water or steam, with or without chemical surfactants, is a common petroleum industry technique to enhance product recovery. In the geothermal industry, reinjection (reinjection is used to mean the injection of ground water that was previously injected) of heat- depleted subsurface fluids is commonly used to maintain reservoir pressure, thus prolonging field productivity. The use reinjection in ground-water remediation projects allows for the application of both traditional production field management and a variety of additional enhancements to the cleanup process. Development of the ideas in this paper was stimulated by an initial suggestion by Dr. Jacob Bear (personal discussions, 1990–1991) that reinjected water might be heated to aid the desorption process.

24794 (UCRL-JC–110353) **Overview of the Dynamic Underground Stripping demonstration project.** Aines, R. (Lawrence Livermore National Lab., CA (United States)); Newmark, R.; McConachie, W.; Rice, D.; Ramirez, A.; Siegel, W.; Buettner, M.; Daily, W.; Krauter, P.; Folsom, E.; Boegel, A.J.; Bishop, D.; Udell, K. Lawrence Livermore National Lab., CA (United States). Aug 1992. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-920851–94: Spectrum '92: nuclear and hazardous waste management international topical meeting, Boise, ID (United States), 23-27 Aug 1992). Order Number DE93012477. Source: OSTI; NTIS; GPO Dep.

Dynamic Underground Stripping is a limited-scope demonstration of a system of thermal remediation and underground imaging techniques for use in rapid cleanup of localized underground spills. Called "Dynamic Stripping" to reflect the rapid and controllable nature of the process, it combines steam injection, direct electrical heating, and tomographic geophysical imaging in a cleanup of the LLNL gasoline spill. The system is targeted toward the removal of free-phase organics of all kinds. The LLNL gasoline spill is a convenient test site because much of the gasoline has been trapped below the water table, mimicking the behavior of dense organic liquids.

24795 (UCRL-JC–110525) **Characterization of ground water contamination at the LLNL main site: A case study.** Hoffman, F. Lawrence Livermore National Lab., CA (United States). Jul 1992. 21p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9209159–7: Eurocourse: technologies for environmental cleanup - soil and groundwater, Ispra (Italy), 21-25 Sep 1992). Order Number DE93009291. Source: OSTI; NTIS; GPO Dep.

When volatile organic compounds were discovered in ground water on and off Lawrence Livermore National Laboratory (LLNL), an extensive investigation of the hydrogeology began in, around, and under the site. This investigation involved collection of data concerning the hydrology, geology, and chemistry of the subsurface environment. After a thorough analysis of the existing information, a workplan was devised that allowed the investigation to proceed with built in flexibility to respond to new data as it was acquired. Where the unique characteristics of the site required a different approach to hydrogeologic investigations, new and innovative technologies were developed and deployed, such as a drilling and sampling method designed to allow the evaluation of the vertical distribution of contaminants in a single borehole. As the data were collected, equal attention was paid to methods of storing, arranging, and interpreting the information such that our decision making was well supported. The result is a well-characterized, well instrumented site that can serve as a model for hydrogeologic investigations wherever there is ground water contamination.

24796 (UCRL-JC–110528) **Innovative characterization techniques and decision support systems for ground water contamination projects.** Hoffman, F. Lawrence Livermore National Lab., CA (United States). Jul 1992. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9209159–4: Eurocourse: technologies for environmental cleanup - soil and groundwater, Ispra (Italy), 21-25 Sep 1992). Order Number DE93009252. Source: OSTI; NTIS; INIS; GPO Dep.

Ground water contamination projects throughout the world must be approached as individual and unique problems. Many traditional investigation techniques require modification to meet the needs of site-specific situations. Because the age of the science of contaminant hydrogeology can be measured only in a few decades, the field is ripe for innovation. This paper describes the following new technologies: At Lawrence Livermore National Laboratory (LLNL), we have developed a new drilling and sampling method, which allows the evaluation of the vertical extent of contamination in a single borehole. We are also using new fiber-optic-based chemical analytical sensors that promise to greatly increase the case of obtaining chemical analyses in the subsurface while greatly reducing costs. Because ground water investigations are data intensive, we need the best decision support system information tools to proceed with investigation and cleanup. These tools have three components: a relational database, data analysis tools, and tools for data display.

24797 (UCRL-JC–110530) **A strategy for improving pump and treat ground water remediation.** Hoffman, F. Lawrence Livermore National Lab., CA (United States). Jul 1992. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9209159–6: Eurocourse: technologies for environmental cleanup - soil and groundwater, Ispra (Italy), 21-25 Sep 1992). Order Number DE93009239. Source: OSTI; NTIS; INIS; GPO Dep.

Established pump and treat ground water remediation has a reputation for being too expensive and time consuming, especially when cleanup standards are set at very low levels, e.g., <10 parts per billion (ppb) for volatile organic compounds (VOCs). Although other ground water remediation technologies are currently being examined and show intriguing promise, pump and treat remains the only dependable technology for cleanup of deep (i.e., >50 ft below ground surface) widespread ground water contamination. The perceived shortcomings of pump and treat result from the (1) tendency of most contaminants to sorb to formation materials, thus retarding contaminant removal; (2) geologic complexity, which requires detailed characterization for the design of optimal extraction systems within available resources; and (3) failure to apply dynamic well field management techniques. An alternative strategy for improving pump and treat ground water remediation consists of (1) detailed characterization of the geology, hydrology, and chemistry; (2) use of computer-aided data interpretation, data display, and decision support systems; (3) removal of sources, if possible; (4) initial design for plume containment and source remediation; (5) phased installation of the well field; (6) detailed monitoring of the remediation; (7) active ongoing re-evaluation of the operating well field, including redesign as appropriate (dynamic management); (8) re-injection of treated ground water to speed the flushing of contaminants; and (9) setting of appropriate cleanup levels or goals. Use of some or all of these techniques can dramatically reduce the time required to achieve cleanup goals and thus the cost of ground water remediation.

24798 (UCRL-JC–110622) **Environmental transport and human exposure: A multimedia approach in health-risk policy.** McKone, T.E. Lawrence Livermore National Lab., CA (United States). May 1992. 5p. Sponsored by USDOE, Washington, DC (United States); California State Government, Sacramento, CA (United States). DOE Contract W-7405-ENG-48. (CONF-9111295–1: Environmental research conference multimedia approach on integrated environmental protection, Toronto (Canada), 25-26 Nov

1991). Order Number DE93007501. Source: OSTI; NTIS; GPO Dep.

In his treatise Air, Water, and Places, the ancient-Greek physician Hippocrates demonstrated that the appearance of disease in human populations is influenced by the quality of air, water, and food; the topography of the land; and general living habits. This approach is still relevant and, indeed, the conerstone of modem efforts to relate public health to environmental factors. What has changed is the precision with which we can measure and model these long-held relationships. Environmental scientists recognize that plants, animals, and humans encounter environmental contaminants via complex transfers through air, water, and food and use multimedia models to evaluate these transfers. In this report, I explore the use of multimedia models both to examine pollution trends and as a basis for characterizing human health risks and ecological risks. The strengths and weaknesses of the approach are discussed.

24799 (UCRL-JC–110957) **The role of data management and decision support systems in the implementation of smart pump and treat.** Rice, D.W. Jr.; Boegel, A.J.; Johnson, V.M.; Cederwall, P.L.; Qualheim, B.J.; Johnson, R.R.; Aines, R.D.; Canales, T.W.; Ridley, M.N.; Nichols, E.M.; Ziagos, J.P. Lawrence Livermore National Lab., CA (United States). Mar 1992. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9204121–4: Innovative technologies for cleaning the environment: air, water, and soil, Erice (Italy), 22-29 Apr 1992). Order Number DE93010513. Source: OSTI; NTIS; INIS; GPO Dep.

Smart pump and treat is made possible by recent advances in information processing that allow rapid analysis of massive volumes of data generated by environmental remediation activities. A critical element in smart pump and treat ;is the establishment of a decision support system that will allow the rapid interpretation of data so that informed decisions can be made at each succeeding step in the remedial process.

24800 (UCRL-JC–110959) **Technologies for environmental cleanup: Soil and ground water.** Ragaini, R.C. Lawrence Livermore National Lab., CA (United States). Jul 1992. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9209159–5: Eurocourse: technologies for environmental cleanup - soil and groundwater, Ispra (Italy), 21-25 Sep 1992). Order Number DE93009513. Source: OSTI; NTIS; GPO Dep.

This is the first of a series of four EUROCOURSES that will be conducted under the title of "Technologies for Envirommental Cleanup." This first course will address the needs of today's environmental protection managers who must deal with the cleanup of soil and ground water contamination. It focuses on recent developments in the areas of policies and regulations, characterization. of.contaminants, subsurface transport and fate of contaminants, cleanup technologies, contaminant risk analysis, and cleanup strategies. Until the goal of acceptable cleanup is achieved, dissemination of information about available cleanup techniques is essential - through courses such as these developed by experts in the US and Europe especially for governmental and industrial managers throughout the world.

24801 (UCRL-JC–111786) **Use of three-dimensional, high-resolution seismic technology to optimize the location of remedial systems.** Bainer, R.W. (Lawrence Livermore National Lab., CA (United States)); Adams, M.L. Lawrence Livermore National Lab., CA (United States). Feb 1993. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-930257–2: 3. international symposium of field screening methods for hazardous wastes and toxic chemicals, Las Vegas, NV (United States), 24-26 Feb 1993). Order Number DE93009064. Source: OSTI; NTIS; INIS; GPO Dep.

Two three-dimensional (3-D), high-resolution seismic reflection pilot studies were conducted in California at two sites, where the primary contaminants of concern are solvents. Identify pathways of contaminant migration. Determine the subsurface stratigraphy and structure to optimize the location for placement of remedial systems. The geology at the first site, located at the Lawrence Livermore National Laboratory in Livermore, California, is characterized by unconsolidated alluvium. Ground water varies in depth from about 30 to 100 ft. The site typically is subjected to extensive cultural noise. The second site, in Southern California, is located in a broad, synclinal depression in the Transverse Range. Shallow alluvium overlies a marine turbidite sequence that crops out as massive sandstone beds. Field work for both surveys took place in August 1992. A Bison Model 90120-A, 120-channel (DIFP) seismograph was used to record the data. Thirty-hertz, natural-frequency geophones were used to receive the data, and an Elastic Wave Generator (EWG) was used as the seismic source. The use of a signal-stacking, noninvasive source was found to be an effective method of overriding background noise at the sites. Prior to the commencement of the 3-D pilot studies, a two-dimensional (2-D) profile was recorded to test the acquisition parameters, which included the geometry of the survey, digital sample rate, and analog filter settings. The data were monitored in the field with a Bison 486 Explorer outdoor computer. The 2-D data were processed and displayed in the field. Both sites displayed coherent seismic reflections from the depths of interest on the field-stacked sections.

24802 (UCRL-JC–112395) **Ultraviolet/hydrogen peroxide oxidation as an alternative to incineration for Rocky Flats combustible wastes.** Wang, F.; Lum, B.; Cassidy, K. Lawrence Livermore National Lab., CA (United States). Dec 1992. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-930160–12: 2. semi-annual Office of Technology Development (OTD) information meeting, Houston, TX (United States), 26-28 Jan 1993). Order Number DE93009226. Source: OSTI; NTIS; GPO Dep.

Ultraviolet/hydrogen peroxide (UV/H_2O_2) oxidation is an established technology, often used in groundwater remediation, where large volumes of effluent containing traces of organic contaminants are treated. With appropriate LTV wavelengths (200–250 mn), hydrogen peroxide undergoes photochemical decomposition by the UV light to produce OH· radicals that are capable of oxidizing many organic compounds. However, the treatment is generally considered acceptable if toxic organic compounds are only partially oxidized into nontoxic compounds. Recent work at LLNL and at Purus, Inc., San Jose, has focused on improving the efficiency of the process and achieving complete mineralization of all likely organic contaminants. In 1992, at EG&G's request we began an evaluation of the UV/H_2O_2 process as an alternative to incineration of Rocky Flats Plant low level combustible mixed wastes such as cutting oils (e.g. Trimsol) and cellulosic materials.

24803 (WHC-SA–1883) **The reduction of packaging waste.** Raney, E.A.; McCollom, M.; Hogan, J. Westinghouse Hanford Co., Richland, WA (United States). Apr 1993. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. (CONF-930483–3: 9. waste minimization and pollution prevention conference, San Francisco, CA (United States), 13-15 Apr 1993). Order Number DE93012619. Source: OSTI; NTIS; GPO Dep.

Nationwide, packaging waste comprises approximately one third of the waste being sent to our solid waste landfills. These wastes range from product and shipping containers made from plastic, glass, wood, and corrugated cardboard to packaging fillers and wraps made from a variety of plastic materials such as shrink wrap and polystyrene peanuts. The amount of packaging waste generated is becoming an important issue for manufacturers, retailers, and consumers. Elimination of packaging not only conserves precious landfill space, it also reduces consumption of raw materials and energy, all of which result in important economic and environmental benefits. At the US Department of Energy-Richland Field Office's (DOE-RL) Hanford Site as well as other DOE sites the generation of packaging waste has added importance. By reducing the amount of packaging waste, DOE also reduces the costs and liabilities associated with waste handling, treatment, storage, and disposal.

24804 (WHC-SA–1896) **Environmental remediation of the 200 Areas, Hanford Site, Washington.** Johnson, W.L.; Wittreich, C.D. Westinghouse Hanford Co., Richland, WA (United States). Apr 1993. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. (CONF-9304117–2: International waste management conference, San Juan (Puerto Rico), 28 Apr 1993). Order Number DE93012615. Source: OSTI; NTIS; INIS; GPO Dep.

The Hanford Site, established in 1943, was originally designed, built, and operated to produce plutonium for nuclear weapons using production reactors and chemical reprocessing plants. Operations in the 200 Areas were mainly related to separation of special nuclear materials from spent nuclear fuel and contain related chemical and fuel processing and waste management facilities. Large quantities of chemical and radioactive waste associated with these processes were often disposed to the environment. This has resulted in extensive contamination in several types of environmental media including air, vadose zone, groundwater, surface water, ground surface, and biota. Efforts are currently underway to remediate chemical and nuclear processing areas of the Hanford Site. Because of the complexity and extent of environmental contamination that has resulted from decades of hazardous and radioactive waste disposal practices, an innovative approach to remediating the site was required. A comprehensive study, referred to as the 200 Aggregate Area Management Study (AAMS) Program, of waste disposal and environmental monitoring data with field investigations was conducted in 1992 to assess the scope of the remediation effort and to develop a plan to expedite the cleanup process.

24805 (WSRC-TR–92-510) **H-Area Seepage Basins groundwater monitoring report, third quarter 1992.** Westinghouse Savannah River Co., Aiken, SC (United States). Dec 1992. 534p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE93012792. Source: OSTI; NTIS; GPO Dep.

During third quarter 1992, the groundwater at the H-Area Seepage Basins (HASB) was monitored in compliance with South Carolina Hazardous Waste Management Regulations, R61-79.265, Subpart F. One hundred thirty wells provided samples from the three separate hydrostratigraphic units that make up the uppermost aquifer beneath the HASB. A detailed description of the uppermost aquifer is included in the Resource Conservation and Recovery Act Part B Post-Closure Care Permit Application for the H-Area Hazardous Waste Management Facility submitted to the South Carolina Department of Health and Environmental Control in December 1990. Historically, as well as currently, tritium, nitrate, mercury, and gross alpha have been the primary constituents observed above the US Environmental Protection Agency Primary Drinking Water Standards (PDWS) in groundwater at the HASB. Nonvolatile beta has consistently exceeded its drinking water screening level. Other radionuclides and hazardous constituents also have exceeded the PDWS in the groundwater at the HASB. Isoconcentration maps included in this report indicate both the concentration and extent of the primary contaminants in each of the three hydrostratigraphic units. Water-level maps indicate that the groundwater flow rates and directions at the HASB have remained relatively constant since the basins ceased to be active in 1988.

24806 (WSRC-TR–92-511) **Mixed Waste Management Facility (MWMF) groundwater monitoring report: Third quarter 1992.** Thompson, C.Y. Westinghouse Savannah River Co., Aiken, SC (United States). Dec 1992. 757p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE93012125. Source: OSTI; NTIS; GPO Dep.

During third quarter 1992, 12 constituents exceeded the US Environmental Protection Agency Primary Drinking Water Standards (PDWS) in one or more groundwater samples from monitoring wells at the Mixed Waste Management Facility and adjacent facilities. Tritium and trichloroethylene were the most widespread constituents: 57 (48%) and 23 (19%) of the 119 monitoring wells contained elevated tritium and trichloroethylene levels, respectively. Elevated constituents were found primarily in Aquifer Zone IIB_2 (Water Table) and Aquifer Zone IIB_1 (Barnwell/McBean). Elevated constituents also occurred in five Aquifer Unit IIA (Congaree) wells. Upgradient wells BGO 1D and 2D and HSB 85A, 85B, and 85C did not contain any constituents that exceeded the PDWS. Downgradient wells in the three hydrostratigraphic units contained elevated levels of tritium, trichloroethylene, tetrachloroethylene, chloroethene, antimony, 1,1-dichloroethylene, gross alpha, lead, nonvolatile beta, thallium, total alpha-emitting radium (radium-224 and radium-226), or cadmium.

24807 (WSRC-TR–92-518) **F- and H-Area Sewage Sludge Application Sites groundwater monitoring report, third quarter 1992.** Westinghouse Savannah River Co., Aiken, SC (United States). Jan 1993. 64p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE93012152. Source: OSTI; NTIS; GPO Dep.

During third quarter 1992, the four wells at the F-Area Sewage Sludge Application Site (FSS wells) and the three wells at the H-Area Sewage Sludge Application Site (HSS wells) were sampled and analyzed for constituents required quarterly by South Carolina Department of Health and Environmental Control Construction Permit 12,076. The F-Area Sewage Sludge Application Site wells also were analyzed for a number of other constituents not required by the permit. Mercury exceeded the Primary Drinking Water Standard (PDWS) in one analysis from well FSS 2D, and tritium exceeded the PDWS in wells FSS 2D and 3D. The mercury result above PDWS is considered suspect because it was not supported by a reanalysis from the same sample or by historical data. Iron exceeded the SRS Flag 2 criterion in wells FSS 3D, lead exceeded its criterion in wells FSS 3D and HSS 3D, and manganese exceeded its Flag 2 criterion in wells FSS 2D and 3D.

24808 (WSRC-TR–93-058) **F-Area Seepage Basins groundwater monitoring report: Fourth quarter 1992 and 1992 summary.** Westinghouse Savannah River Co., Aiken, SC (United States). Mar 1993. 394p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE93013584. Source: OSTI; NTIS; INIS; GPO Dep.

During fourth quarter 1992, the groundwater at the F-Area Seepage Basins (FASB) was monitored in compliance with South Carolina Hazardous Waste Management Regulations, R61-79.265, Subpart F. Eighty-five wells provided samples from the three hydrostratigraphic units that make up the uppermost aquifer beneath the FASB. A detailed description of the uppermost aquifer is included in the Resource Conservation and Recovery Act Part B Post-Closure Care Permit Application for the F-Area Hazardous Waste Management Facility submitted to the South Carolina Department of Health and Environmental Control in December 1990. Historically, as well as currently, tritium, nitrate, gross alpha, total alpha-emitting radium, cadmium, and lead are the primary constituents observed above final Primary Drinking Water Standards (PDWS) in groundwater at the FASB. Nonvolatile beta has consistently exceeded its drinking water screening level. Other radionuclides and hazardous constituents also have exceeded the final PDWS in the groundwater at the FASB. The elevated constituents are found primarily in Aquifer Zone IIB_2 (Water Table) and Aquifer Zone IIB_1, (Barnwell/McBean) wells. However, several Aquifer Unit IIA (Congaree) wells also contain elevated levels of constituents, primarily tritium. Isoconcentration/isoactivity maps included in this report indicate both the concentration/activity and extent of the primary contaminants in each of the three hydrostratigraphic units for first and fourth quarters 1992. Water-level maps indicate that the groundwater flow rates and directions at the FASB have remained relatively constant since the basins ceased to be active in 1988.

24809 (WSRC-TR–93-066) **P-Area Acid/Caustic Basin groundwater monitoring report: Fourth quarter 1992 and 1992 summary.** Thompson, C.Y. Westinghouse Savannah River Co., Aiken, SC (United States). Mar 1993. 55p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE93013695. Source: OSTI; NTIS; GPO Dep.

During fourth quarter 1992, samples from the six PAC monitoring wells at the P-Area Acid/Caustic Basin were analyzed for indicator parameters, groundwater quality parameters, and parameters characterizing suitability as a drinking water supply. Monitoring results that exceeded the final Primary Drinking Water Standards (PDWS) or the Savannah River Site (SRS) flagging criteria or turbidity standard during the quarter are discussed in this report. During fourth quarter 1992, a sample from well PAC 6 exceeded the SRS turbidity standard. Iron and manganese each exceeded its Flag 2 criterion in wells PAC 2, 5, and 6. No analytes exceeded the final PDWS in wells at the P-Area Acid/Caustic Basin during 1992.

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Refer also to citation(s) 22843, 22844, 23032, 23045, 23092, 23093, 23220, 23268, 23538, 23543, 23737, 23744, 23831, 23832, 24058, 24069, 24071, 24072, 24081, 24082, 24573, 24582, 24629, 24631, 24632, 24636, 24640, 24642, 24666, 24672, 24677, 24678, 24682, 24684, 24722, 24741, 24745, 24746, 24747, 24759, 24761, 24762, 24767, 24768, 24771, 24776, 24798, 24800, 24866, 24873, 24891, 24901, 24906, 24907

24810 (BNL–48858) **Preliminary results of the comparison of ATSR measurements with in situ sea temperatures.** Minnett, P.J. Brookhaven National Lab., Upton, NY (United States). 17 Mar 1993. 42p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. Grant NA26GP0266-01. (CONF-9303167–1: Along Track Scanning Radiometer (ATSR) science team meeting, Abingdon (United Kingdom), 30 Mar 1993). Order Number DE93013399. Source: OSTI; NTIS; GPO Dep.

During October and November, 1991, the NATO Research Vessel Alliance sailed from Amsterdam into the western Mediterranean Sea and during this time measurements were made for the validation of ATSR data. This document reports the initial comparison between ATSR measurements and sea-surface temperatures (SSTs) taken along the ship's track by an in situ thermometer at a depth of about 3m.

24811 (CFS/OO–46-13/35-1991E, pp. 266-302) **Chemical characteristics of precipitation, stream flow, lake water and sediments quality in northern temperate forest watersheds threatened by acidic atmospheric inputs.** Ouellet, M. (Quebec Univ., Ste-Foy, PQ (Canada)); Jones, H.G.; Auclair, J.C. Canadian Forestry Service, Ottawa, ON (Canada). 1991. (CONF-8306311–: Effects of acid rain on forest resources, Sainte-Foy (Canada), 14-17 Jun 1983; MICROLOG–92-03656). In *Effects of acid rain on forest resources: Proceedings.* 667p. Source: PC Forestry Canada, Place Vincent Massey, 351 St. Joseph Blvd., Ottawa, ON, CAN K1A 1G5; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1 PC PRICES UPON REQUEST; MF $10 CAN.

Studies were carried out on the spatial and temporal distribution of certain chemical parameters of precipitation, lake water quality and paleolimnological profiles of the sediments in certain forested watersheds in the Laurentides Park, Quebec. The results establish the current response of watersheds to the present acidic atmospheric loading and indicate recent perturbations in the natural chemical flux within these systems. The effect of forest cover on the chemical characteristics of individual rain events in the spring and summer seasons is greater in magnitude than the variability between incoming precipitation episodes. Stream flow quality is little affected by changes in throughfall and seems to be more associated with total anion charge rather than pH level. The winter accumulation of acidic pollutants in the snow pack leads to an appreciable depression of pH levels during snowmelt with concomitant increases in aluminum concentrations and manganese/iron ratios of the stream waters. Long term changes in the water quality of the tributaries are reflected in the chemical profiles of such metals as Al and Mn in the most recent (0-100 y) lake sediments. The Pb, Zn and Hg concentration profiles of the upper 0-30 cm layer are good indicators of pollutant-load fluctuations in the recent past. A more complex type of profile is shown by ^{137}Cs, which is dependent on the nature of the watershed vegetation and shows different patterns of concentration in the surficial 0-10 cm of lake sediments. 88 refs., 15 figs., 4 tabs.

24812 (CFS/OO–46-13/35-1991E, pp. 429-437) **Time trends in selected chemical characteristics of streamflow from an undisturbed watershed in West Virginia.** Helvey, J.D. (United States Dept. of Agriculture, Parsons, WV (United States)); Kochenderfer, J.N. Canadian Forestry Service, Ottawa, ON (Canada). 1991. (CONF-8306311–: Effects of acid rain on forest resources, Sainte-Foy (Canada), 14-17 Jun 1983; MICROLOG–92-03656). In *Effects of acid rain on forest resources: Proceedings.* 667p. Source: PC Forestry Canada, Place Vincent Massey, 351 St. Joseph Blvd., Ottawa, ON, CAN K1A 1G5; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1 PC PRICES UPON REQUEST; MF $10 CAN.

Stream chemistry records for a 38.9 ha watershed, undisturbed since 1910, were analyzed for time trends in pH between 1958 and 1982, and calcium, magnesium and sodium concentrations between 1970 and 1982. The pH analysis was inconclusive because of an instrument change in 1975, but changes, if they occurred, were very small. There was no change in levels of sodium, potassium or magnesium, but specific conductance and calcium concentrations have increased slightly in recent years. The cause for these changes is uncertain, but precipitation acidity could be influencing the chemical content of streamflow from this watershed. 10 refs., 4 figs.

24813 (CONF-9209335–1) **The significance of interactions of humic substances and organisms in the environment.** McCarthy, J.F.; Strong-Gunderson, J.; Palumbo, A.V. Oak Ridge National Lab., TN (United States). [1992]. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From International Humic Substances Society meeting; Bari (Italy); 20-25 Sep 1992. Order Number DE93011861. Source: OSTI; NTIS; INIS; GPO Dep.

Environmental Sciences Division Publication No. 4046.

The diverse roles of humic substances in biological processes, and differences in the status of our understanding of these processes, is illustrated by examining two interactions. A significant body of literature elucidating the significance of natural organic matter (NOM) on the bioaccumulation of hydrophobic organic contaminants (HOC) by aquatic organisms is consistent with a general conclusion that HOC associated with NOM is not available for uptake by fish or aquatic invertebrates. In contrast to this relatively well-understood process, very little is known about the role of NOM in the ecology and nutrient dynamics of microbial communities in very deep subsurface environments.

24814 (CONF-921275–, pp. 71-74) **Removal of nitrate using catalyst loaded metal powder.** Sasaki, H. (Yokohama National University, Yokohama (Japan). Faculty of Engineering); Okazaki, S.; Kuraya, E.; Asakura, S. 2 Dec 1992. 160p. (In Japanese). From 25. safety engineering study meeting; Kitakyushu (Japan); 2-3 Dec 1992. In *Proceedings of the 25th Safety Engineering Study Meeting.* Order Number DE93793904. Source: OSTI; NTIS (US Sales Only).

On the occasion that contamination of natural water with nitrate becomes a more serious problem, this paper discusses a method to remove nitrate ions using catalyst loaded metal powder which is inexpensive and whose eluates are harmless. First, iron powder of 100 mesh was activated by immersing it in 1N hydrochloric acid, and then immersed in copper nitrate aqueous solution to have the copper loaded. The experiment used 10^{-3} M sodium nitrate aqueous solution of pH 6.8 added with the copper loaded iron powder (hereinafter Cu-Fe) to investigate time-based change in concentrations of nitrate ions, nitrite ions, and ammonium ions. The nitrate ion concentration decreased apparently with time in a relationship of a primary expression. Various findings were obtained including the relationship between velocity constants and amounts of the loaded copper. Next, an experiment was carried out with the Cu-Fe filled in a column and the solution flowing, in which the pH change in the solution in the column reduced rapidly the nitrate ion removal rate. The experiment concluded that an installation of some kind of a pH adjusting mechanism would enable to maintain high removal rate. 6 figs.

24815 (DOE/ER/61438–T1) **Origins and fates of DOM along the New England continental margin: Techical progress report, Year 1.** Fry, B. (Marine Biological Lab., Woods Hole, MA (United States). Ecosystems Center); Hopkinson, C.; Altabet, M. Marine Biological Lab., Woods Hole, MA (United States). Ecosystems Center. [1993]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-92ER61438. Order Number DE93014282. Source: OSTI; NTIS; GPO Dep.

We have focused on methods development and completed an initial survey of Dissolved Organic Matter (DOM) concentration and isotopic composition during the 1994 spring bloom on Georges Bank. The methods development phase assures that high quality measurements will be made in years 2 and 3, and emphasizes developing two independent methods for DON determination. The survey work on Georges Bank will be extended in years 2 and 3 to

determine seasonal and spatial changes in DOM concentrations and isotopic compositions along the eastern US continental margin, from Georges Bank to Cape Hatteras.

24816 (DOE-RAS–92.004) **Environmental behaviour of radioactivity from Chernobyl: Brothers Water study.** Bonnett, P.J.P. (AEA Environment and Energy North, Billingham (United Kingdom)); Appleby, P.G.; Oldfield, F.; Haworth, E.Y.; Hilton, J.; Davison, W. Department of the Environment, London (United Kingdom). Radioactive Substances Div. 1992. [82p.] Contract PECD-7/9/359;HP 4.55.13. Order Number DE93625634. Source: OSTI; NTIS (US Sales Only); INIS.

A study has been carried out to examine the short term behaviour of Chernobyl derived radionuclides together with the longer term patterns of transport of weapons fallout derived ^{137}Cs first studied on the Brothers Water catchment in the English Lake District in the 1970's. Chernobyl derived radiocaesium is observable in the soils and lake sediments of the catchment. ^{210}Pb dating and diatom analysis were used to confirm that the lake sediments sampled were undisturbed. A simple box model is used to estimate radionuclide inventories in Brothers Water Lake sediments. Estimates derived using this model are reasonably consistent with estimates obtained from a variety of other sources. (author).

24817 (DOE-RAS–92.005) **Transport processes of Cs-137 in lake environments.** Hilton, J. (Inst. of Freshwater Ecology, Windermere (United Kingdom)); Carrick, T.R.; Lishman, J.P.; Rigg, E.; Davison, W.; Kelly, M.; Hamilton-Taylor, J. Department of the Environment, London (United Kingdom). Radioactive Substances Div. 1992. [89p.] Contract PECD-7/9/385. Order Number DE93625635. Source: OSTI; NTIS (US Sales Only); INIS.

Radiocesium levels in the waters of the Lake District dropped after the initial deposition following the Chernobyl reactor accident. However they continued to be measurable several years after the event. Caesium 137 concentrations were measured in the sediments of Esthwaite water and Windermere to determine the input of caesium 137 from the catchment area to the lakes. Experiments were conducted to ascertain the chemical conditions such as pH value, adsorption, competing ions which might contribute to maintaining caesium levels in the lakes. (U.K.).

24818 (DOE-RAS–92.008) **Radiological assessment of private water supplies in the Borough of Beverley, East Yorkshire, England.** ICI Tracerco, Billingham (United Kingdom). 1992. [43p.] Sponsored by Department of the Environment, London (United Kingdom). Radioactive Substances Div. Contract PECD-7/9/539;DG-LF-379. Order Number DE93624537. Source: OSTI; NTIS (US Sales Only); INIS.

Water samples from 100 private water supplies in the Borough of Beverley have been analysed for natural and artificial radionuclides and the elements Calcium and Strontium. In addition, 20 of the 100 supplies were specifically sampled for the measurement of Radon-222. Of the 100 supplies tested, all total alpha and beta analyses were within the WHO guideline values. An assessment of the radiological significance of the analytical data has been carried out by calculating the committed effective dose equivalent to a hypothetical "critical" group, which would arise from the consumption of water during a single year. The maximum adult annual committed effective dose equivalent for artificial and total radionuclides measured during this programme of monitoring was found to be 1.50 and 20.9 μSv, respectively. (author).

24819 (DOE-RAS–92.015) **Radioactive fallout in air and rain: results to the end of 1990.** Playford, K. (AEA Environment and Energy, Harwell (United Kingdom)); Lewis, G.N.J.; Carpenter, R.C. AEA Environment and Energy, Harwell (United Kingdom). 1992. [27p.] Sponsored by Department of the Environment, London (United Kingdom). Radioactive Substances Div. Contract PECD-7/9/537. (AEA-EE–0362.). Order Number DE93624538. Source: OSTI; NTIS (US Sales Only); INIS.

Samples of atmospheric particulate and rainwater have been collected from the United Kingdom and elsewhere. Results are presented of analyses of these samples for various fission products and certain other radionuclides. Average concentrations of Cs-137 in air in the United Kingdom in 1990 were 1% of those in 1986. They were attributable mainly to the resuspension of deposited activity resulting from the Chernobyl accident of April 1986. Plutonium concentrations in air and rainwater were a very small fraction of the National Radiological Protection Board's Generalised Derived Limit for members of the public. Estimates are given of the worldwide deposit of Cs-137 and Sr-90 to the end of 1990. The gamma and beta-ray dose rates from fallout at Chilton are estimated from the observed deposition. (author).

24820 (DUN–6205) **Chemicals discharged to the Columbia River from DUN facilities, fiscal year 1969.** Reilly, L.F.; Wells, G.W. Douglas United Nuclear, Inc., Richland, WA (United States). 1969. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93012158. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report summarizes the chemical disposal data from facilities operated by Douglas United Nuclear, Inc., during fiscal year 1969. The total quantity of chemicals discharged to the Columbia River from the Single-Pass Reactor facilities is detailed in Section I and from the N Reactor facilities in Section II. In addition to the gross quantities shown, supplementary information has been included to note the manner and normal rate of discharge. Section III summarizes the disposal frequencies and estimated quantities of chemicals discharged to the 300 Area process ponds from DUN facilities. These materials are discharged to the process sewer and flow to the 300 Area process ponds. A portion of the chemicals reach the Columbia River through underground seepage. As the process sewer system in the 300 Area serves other companies as well, the controls established by DUN include routine composite sampling of the 300 Area process ponds. The automatic sampler collects integrated samples of pond inlet water that are analyzed weekly. This analytical data is included as Section IV.

24821 (DUN–7162) **Chemicals discharged to the Columbia River from DUN facilities, fiscal year 1970.** Wells, G.W.; Grubb, F.W. Douglas United Nuclear, Inc., Richland, WA (United States). 1970. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93012159. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report summarizes the chemical disposal data from facilities operated by Douglas United Nuclear, Inc., during Fiscal Year 1970. The total quantity of chemicals discharged to the Columbia River from the Single-Pass Reactor facilities is detailed in Section I and from the N Reactor facilities in Section II. In addition to the gross quantities shown, supplemental information has been included to note the manner and normal rate of discharge. Section III summarizes the disposal frequencies and estimated quantities of chemicals discharged to the 300 Area process ponds from DUN facilities. These materials are discharged to the process sewer and flow to the 300 Area process ponds. A portion of the chemicals reach the Columbia River through underground seepage. Section III also includes a report of the former Plutonium Recycle Test Reactor water plant. Douglas United Nuclear, Inc., placed this facility in operation in FY 1970 to supply a portion of the area water needs formerly supplied by the City of Richland. As the process sewer system in the 300 Area serves other companies as well, the controls established by DUN include routine composite sampling of the 300 Area process ponds. The automatic sampler collects integrated samples of pond inlet water that are analyzed weekly. This analytical data is included in Section IV.

24822 (ETDE-mf–93792708) **Denitrification of special waste waters using external carbon sources.** Veroeffentlichungen des Instituts fuer Siedlungswasserwirtschaft, Technische Universitaet Braunschweig. Wolffson, C. Technische Univ. Braunschweig (Germany). Inst. fuer Siedlungswasserwirtschaft. 1992. 242p. (In German). Order Number DE93792708. Source: OSTI; NTIS (US Sales Only).

Experiments on a semi-technical scale revealed that the organic substrate in coking plant waste water, which results for a large part from phenol, cannot be used for denitrification of nitrified blast furnace gas scrubbing water and coking plant waste water. Instead, external addition of carbon was required to achieve low nitrate concentrations in the effluent. Adverse effects of cyanide, thiocyanate and nitrite were not observed as long as these were present in low concentrations. On the whole, it can be said that nitrogen can be

largely removed even from tricky waste waters as long as increased automatic control effort and supply with a suitable organic substrate are made allowance for. This presupposes a process technology matching the quality of waste water in each specific case and the cleaning target set. (orig./EF).

24823 (GKSS–92/E/48) **Absorption and transformation of mercury(II) and methylmercury chloride by suspended bacteria and microbial biofilms - investigations on the species behaviour of mercury in aqueous systems.** Ebinghaus, R. (GKSS-Forschungszentrum Geesthacht GmbH, Geesthacht-Tesperhude (Germany). Inst. fuer Chemie). GKSS-Forschungszentrum Geesthacht GmbH, Geesthacht-Tesperhude (Germany); Hamburg Univ. (Germany). Fachbereich 13 - Chemie. 1992. 159p. (In German). Order Number DE93792032. Source: OSTI; NTIS (US Sales Only).

Knowledge concerning transformation reactions of pollutants attached to suspended material in the river Elbe is very limited. In the present work the influence of bacteria and microbial biofilms on dynamic species transformations of mercury was investigated. Bacteria and microbial biofilms are capable of accumulating different mercury species in comparable concentrations. The formation of highly toxic monomethylmercury is more effective in the presence of organotin, -lead and -arsenic compounds via a transmethylation reaction than in the presence of biogenic methyldonators. Under oxic conditions bacteria isolated from suspended particulate matter decompose methylmercury to inorganic Hg(II) which is immobilized in the cells. (orig.) With 40 figs., 22 tabs.

24824 (GKSS–92/E/49) **4th Magdeburg seminar on prevention of water pollution - the situation of the river Elbe.** Wilken, R. D. (GKSS-Forschungszentrum Geesthacht GmbH, Inst. fuer Gewaesserforschung, Magdeburg (Germany)); Beyer, M.; Guhr, H. GKSS-Forschungszentrum Geesthacht GmbH, Geesthacht-Tesperhude (Germany). 1992. 376p. (In German). (CONF-9209352–: 4. Magdeburg seminar on prevention of water pollution - the situation of the river Elbe, Spindleruv Mlyn (Czechoslovakia), 22-26 Sep 1992). Order Number DE93792031. Source: OSTI; NTIS (US Sales Only).

From September 22nd-26th, 1992, the '4. Magdeburger Gewaesserschutzseminar - die Situation der Elbe -' (4th Magdeburg Seminar on prevention of water pollution - the situation of the river Elbe) took place in Spindleruv Mlyn, Czechoslovakia. These proceedings contain 75 contributions on the latest developments in Elbe research and Elbe pollution under the sections: Pollution of the Elbe: sources, situation, trends, transport; Ecology of the polluted Elbe; River construction; Measuring strategies for monitoring the Elbe; Modelling; Quality objectives and strategies. (orig.). With 103 figs., 92 tabs.

24825 (GKSS–92/E/50) **Analytical investigations for the determination of the chemical bonds (speciation) of tin in the sediments of the river Elbe by means of GC-AAS, GC-MS, TRFA and GFAAS.** Jantzen, E. (GKSS-Forschungszentrum Geesthacht GmbH, Geesthacht-Tesperhude (Germany). Inst. fuer Physik). GKSS-Forschungszentrum Geesthacht GmbH, Geesthacht-Tesperhude (Germany); Hamburg Univ. (Germany). Fachbereich 13 - Chemie. 1992. 231p. (In German). Order Number DE93792030. Source: OSTI; NTIS (US Sales Only).

Until now the behaviour of tin and organotin species in sediments of the river Elbe has been poorly investigated. Hence analytical procedures for their determination, prototypic for mercury, lead and selenium as well, were developed and verified. The application of this speciation technique to investigations of transformation and transport processes is discussed. A newly developed GC-Quarzfurnace-ASS-System was used as analytical and GC-MS as reference principle. 'Insitu'-reactions with sodiumtetraethylborate (NaBEt4) made the various tin species and their patterns accessible. Natural and anthropogenic tin species as well as mixed forms were identified. Mobile and immobile tin forms were also distinguishable. Total tin was determined by TXRF and Zeeman-AAS. Elbe sediments are polluted with toxic organotin species, but the high content of tetrabutyltin from industrial emission, previously observed, was conspicuous. (orig.) With 57 figs., 43 tabs.

24826 (K/EM–24/R2) **Biological Monitoring and Abatement Program for the Oak Ridge K-25 Site.** Kszos, L.A. (Oak Ridge National Lab., TN (United States)); Adams, S.M.; Ashwood, T.L.; Blaylock, B.G.; Greeley, M.S.; Loar, J.M.; Peterson, M.J.; Ryon, M.G.; Smith, J.G.; Southworth, G.R.; Hinzman, R.L.; Shoemaker, B.A. Oak Ridge K-25 Site, TN (United States). Environmental Management Div.; Oak Ridge National Lab., TN (United States). Apr 1993. 52p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93013731. Source: OSTI; NTIS; INIS; GPO Dep.

Environmental Sciences Division Publication No. 4009.

A proposed Biological Monitoring and Abatement Program (BMAP) for the Oak Ridge K-25 Site was prepared in December 1992 as required by the renewed National Pollutant Discharge Elimination System permit that was issued on October 1, 1992. The proposed BMAP is based on results of biological monitoring conducted from 1986 to 1992 and discussions held on November 12, 1992, between staff of Martin Marietta Energy Systems, Inc. (Oak Ridge National Laboratory and the K-25 Site), and the Tennessee Department of Environment and Conservation, Department of Energy Oversight Division. The proposed BMAP consists of four tasks that reflect different but complementary approaches to evaluating the effects of K-25 Site effluents on the ecological integrity of Mitchell Branch, Poplar Creek, and the Poplar Creek embayment of the Clinch River. These tasks include (1) ambient toxicity monitoring, (2) bioaccumulation monitoring, (3) assessment of fish health, and (4) instream monitoring of biological communities. This overall BMAP plan combines established protocols with current biological monitoring techniques to assess environmental compliance and quantify ecological recovery. The BMAP will also determine whether the effluent limits established for the K-25 Site protect the designated use of the receiving streams (Mitchell Branch, Poplar Creek, and Clinch River) for growth and propagation of fish and other aquatic life. Results obtained from this biological monitoring program will also be used to document the ecological effects (and effectiveness) of remedial actions.

24827 (LA-SUB–93-48) **Development of an operational tool for biomonitoring using constant pressure respirometry: [Final report].** Zachritz, W.H. II (New Mexico State Univ., Las Cruces, NM (United States)); Morrow, J. Los Alamos National Lab., NM (United States); New Mexico State Univ., Las Cruces, NM (United States). 29 Jun 1992. 28p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. Order Number DE93008674. Source: OSTI; NTIS; INIS; GPO Dep.

The United States Environmental Protection Agency (US EPA) policy statement (FR 49, 9016, 9 March 1984) for the development of water quality based permit limitations includes toxicity testing of effluents as an important part of a water quality approach to controlling toxics (Pickering, 1988). To assure that state waters are free of toxics, both chemical and biological methods were recommended for assessing effluent quality. The US EPA validated bioassay procedures for toxicity testing of wastewater discharges use three distinctive organisms groups: vertebrates, invertebrates, and algae (Weber, 1989). The specific species for these three groups are fathead minnow, Pimephales promelas; water tea, Ceriodaphnia, dubia; and the green algae, Selenastrum capricornum, respectively. Definitive testing estimates the concentration atwhich a certain percentage of organisms exhibit a certain response. The definitive test exposes several replicate groups of organisms to the target substrate for a predetermined time period effluent concentration. The overall goal of this study is to develop an acceptable protocol for operational biomonitoring based on constant pressure respirometry for LANL. The specific objectives include: Development an appropriate toxicity testing protocol based on constant pressure respirometry for whole effluent toxicity testing, and evaluate the protocol based on factors such as sensitivity, response time, cost of analysis, and simplicity of operation.

24828 (LA-UR–93-507) **A continuation method for computing non-linear 3-D free surface flows.** Petersson, N.A. Los Alamos National Lab., NM (United States). Jan 1993. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9305140–1: 8. international workshop on water waves and floating bodies, Newfoundland (Canada), 23-26

May 1993). Order Number DE93008704. Source: OSTI; NTIS; GPO Dep.

The subject of this paper is a pseudo-arclength continuation method for computing non-linear three-dimensional steady potential flow around a submerged body moving in a infinitely deep liquid at constant speed and distance below the free surface.

24829 (MAFF-AEMR–32) **A review of radioactivity in the Irish Sea: A report prepared for the Marine Pollution Monitoring Management Group.** Kershaw, P.J.; Pentreath, R.J.; Woodhead, D.S.; Hunt, G.J. Ministry of Agriculture, Fisheries and Food, Lowestoft (United Kingdom). Directorate of Fisheries Research. 1992. [65p.] Order Number DE93625636. Source: OSTI; NTIS (US Sales Only); INIS.

This review aims to provide a summary of knowledge to date and a stimulus for further work. Sellafield discharges in relation to the Irish Sea, monitoring and modelling are discussed.

24830 (ORNL/CDIAC–54) **Adapting to sea-level rise in the US Southeast: The influence of built infrastructure and biophysical factors on the inundation of coastal areas.** Daniels, R.C. (Tennessee Univ., Knoxville, TN (United States). Energy, Environment and Resources Center); Gornitz, V.M.; Mehta, A.J.; Lee, Saychong; Cushman, R.M. Oak Ridge National Lab., TN (United States). Carbon Dioxide Information Analysis Center. Nov 1992. 268p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93007799. Source: OSTI; NTIS; INIS; GPO Dep.

Environmental Sciences Division Publication No. 3915.

The earth' s global mean surface air temperature has increased by 0.5°C over the past 100 years. This warming trend has occurred concurrently with increases in the concentration and number of greenhouse gases in the atmosphere. These gases may cause this trend to accelerate in the future and result in a net increase in the earth's global mean surface air temperature of 1.5 to 4.5°C by the year 2100. An increase of this magnitude could cause sea surface temperatures to increase would cause sea levels to rise -from thermal expansion of the sea, and the addition of melt waters from alpine glaciers and continental ice sheets. To allow for the cost-effective analysis of the impacts that sea-level rise may have on the US Southeast, a method is needed that will allow sites that are potentially at risk to be identified for study. Previously, no objective method was available to identify such sites. This project addresses this problem by using a geographic data base with information on both physical and climatological factors to identify coastal areas of the US Southeast that are at risk to inundation or accelerated erosion due to sea-level rise. The following six areas were selected for further study from the many identified as being at high risk: Galveston, Texas; Caminada Pass, Louisiana; Bradenton Beach, Florida; Daytona Beach, Florida; McClellanville, South Carolina; and Nags Head, North Carolina. For each study area the amount of land, by land use type, in danger from inundation from three sea-level-rise scenarios was calculated. The calculated values were based on elevation alone.

24831 (ORNL/M–1760) **Environmental Surveillance data report for the fourth quarter of 1992.** Goldberg, P.Y.; Cooper, R.C.; Hamilton, L.V.; Hughes, J.F.; Horwedel, B.M.; Loffman, R.S.; Salmons, M.C.; Stevens, M.M.; Valentine, C.K. Oak Ridge National Lab., TN (United States). Feb 1993. 139p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93009792. Source: OSTI; NTIS; GPO Dep.

The Environmental Surveillance and Protection Section within the Office of Environmental Compliance and Documentation at the Oak Ridge National Laboratory (ORNL) is responsible for the development and implementation of an envirorunental program to (1) ensure compliance with all federal, state, and Department of Energy (DOE) reporting requirements to quantitatively demonstrate prevention, control, and abatement of environmental pollution; (2) monitor the adequacy of containment and effluent controls; and (3) assess impacts of releases from ORNL facilities on the environment. Environmental monitoring, as defined by the Regulatory Guide, consists of two major activities: effluent monitoring and environmental surveillance. Effluent monitoring is the collection and analysis of samples or measurements of liquid and gaseous effluents. Monthly or quarterly summaries are presented in this report for each medium sampled. All data are rounded to two significant digits. The summary tables generally give the number of samples collected during the period and the maximum, minimum, average, and standard error of the mean (SE) values of parameters for which determinations were made.

24832 (PNL-SA–21080) **Tritium concentrations in the Columbia River at Richland.** Dirkes, R.L. Pacific Northwest Lab., Richland, WA (United States). Jan 1993. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-930130–8: 26. Health Physics Society midyear topical meeting on environmental health physics, Coeur d'Alene, ID (United States), 24-28 Jan 1993). Order Number DE93007874. Source: OSTI; NTIS; INIS; GPO Dep.

The concentrations of tritium in the Columbia River, which are measurable using special analytical techniques, have been decreasing during recent years. Tritium levels are significantly greater at the Richland Pumphouse downstream of the Hanford Site than upstream at Priest Rapids Dam. Tritium is known to enter the river along the Hanford Site as direct effluent discharges, which have been virtually eliminated, and through the seepage of ground water contaminated as a result of past operations. The seepage of contaminated ground water has continued, expanding over time to encompass a larger portion of the Hanford shoreline nearer to the downstream Columbia River monitoring station. Cross-sectional sampling of the river was conducted to determine the distribution of tritium across the river and evaluate the relationship between average tritium concentrations in the river and those measured by the downstream river sampling system.

24833 (SAND–92-7286) **Sandia Ocean Modeling System programmer's guide and user's manual.** Dietrich, D. (Ecodynamics Research Associates, Inc., Albuquerque, NM (United States)). Sandia National Labs., Albuquerque, NM (United States); Ecodynamics Research Associates, Inc., Albuquerque, NM (United States). Jan 1993. 141p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. Order Number DE93007427. Source: OSTI; NTIS; GPO Dep.

The Sandia Ocean Modeling System (SOMS) (Dietrich et al., 1987) is not just one model but a modeling methodology to be applied in different modes (coarse or high resolution, boundary layers, with or without realistic topography, in a forecast or phenomenological mode, etc.) according to application requirements, hence its description as a modeling system. SOMS is applicable to a large range of geophysical flows from small lakes to large ocean basins. This document includes a description of governing equations and numerical methods and full details of the coding. Appendix A provides a complete listing of SOMS, including its movie-making modules. Appendix B presents the variables that appear in common blocks; this information is essential for a programmer intending to change the problem dimensions. Appendix C presents the results of a physical parameter sensitivity study. Appendix D presents results of a real ocean calculation.

24834 (SREL–39) **Wetland vegetation establishment in L-Lake.** Kroeger, S.R. Savannah River Ecology Lab., Aiken, SC (United States). Jul 1990. 81p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00819. Order Number DE93013822. Source: OSTI; NTIS; INIS; GPO Dep.

Wetland vegetation was transplanted from PAR Pond to L-Lake between January and August, 1987. Approximately 100,000 individual plants representing over 40 species were transplanted along the southern shoreline. Three zones of vegetation were created: (1) submersed/floating-leaved, (2) emergent, (3) upper emergent/shrub. During the summers of 1987, 1988, 1989, the Savannah River Ecology Laboratory sampled the vegetation in 54 permanent transects located in planted (N=32) and unplanted areas (N=22). The 1989 vegetation data from L-Lake were compared to 1985 data from PAR Pond.

24835 (UBA-FB–92-118) **Development of a simple bacteria test for routine measurements in waste water. Summary of the final reports of the part projects.** Popp, W.; Rheinheimer, G.; Schulz, K.J.; Kalnowski, G.; Krebs, F. Bayerische Landesanstalt fuer Wasserforschung (BayLWF), Muenchen (Germany); Institut fuer Meereskunde an der Univ. Kiel (Germany); Technische Univ.

Berlin (Germany). Fachgebiet Hygiene; Bundesanstalt fuer Gewaesserkunde, Koblenz (Germany); Umweltbundesamt, Berlin (Germany). 1991. 32p. (In German). Contract UFOPLAN 10205307. Order Number DE93795328. Source: OSTI; NTIS (US Sales Only).

The following investigations are described: (1) Isolation and cultivation of marine luminescent bacteria, especially strains with higher optimum temperatures, testing of their applicability in toxicity tests, and attempts to standardize the procedure. (2) Isolation of freshwater strains; distribution of luminescent bacteria in water with different salinities and their applicability in bacterial toxicity tests. (3) Investigations into activity-maintaining conservation of Photobacterium phosphoreum in the low-temperature range, and (4) standardisation of the luminous bacteria test. (orig./BBR) With 9 refs.

24836 (UCRL-JC–112215) **Chemical and biological factors affecting bioavailability of contaminants in seawater.** Knezovich, J.P. Lawrence Livermore National Lab., CA (United States). Sep 1992. 23p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9208217–1: Pellston workshop on chemical bioavailability in aquatic systems, Pellston, MI (United States), 18-21 Aug 1992). Order Number DE93011877. Source: OSTI; NTIS; INIS; GPO Dep.

This paper discusses the influence that salinity has on the bioavailability of the two largest classes of contaminants, trace metals and organic compounds will be discussed. Although data on contaminant toxicity will be used to draw inferences about chemical availability, this discussion will focus on the properties that contaminants are likely to exhibit in waters of varying salinities. In addition, information on physiological changes that are affected by salinity will be used to illustrate how biological effects can alter the apparent availability of contaminants.

24837 (WSRC-MS–92-473) **Application of a simple parameter estimation method to predict effluent transport in the Savannah River.** Hensel, S.J.; Hayes, D.W. Westinghouse Savannah River Co., Aiken, SC (United States). [1993]. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. (CONF-930667–1: International conference on inverse problems in engineering: theory and practice, Palm Coast, FL (United States), 13-18 Jun 1993). Order Number DE93011773. Source: OSTI; NTIS; INIS; GPO Dep.

A simple parameter estimation method has been developed to determine the dispersion and velocity parameters associated with stream/river transport. The unsteady one dimensional Burgers' equation was chosen as the model equation, and the method has been applied to recent Savannah River dye tracer studies. The computed Savannah River transport coefficients compare favorably with documented values, and the time/concentration curves calculated from these coefficients compare well with the actual tracer data. The coefficients were used as a predictive capability and applied to Savannah River tritium concentration data obtained during the December 1991 accidental tritium discharge from the Savannah River Site. The peak tritium concentration at the intersection of Highway 301 and the Savannah River was underpredicted by only 5% using the coefficients computed from the dye data.

24838 (WSRC-MS–92-479) **Metal finishing wastewater pressure filter optimization.** Norford, S.W.; Diener, G.A.; Martin, H.L. Westinghouse Savannah River Co., Aiken, SC (United States). [1992]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. (CONF-9305166–1: American Filtration Society seminar and expo annual meeting, Chicago, IL (United States), 3-6 May 1993). Order Number DE93012139. Source: OSTI; NTIS; GPO Dep.

The 300-M Area Liquid Effluent Treatment Facility (LETF) of the Savannah River Site (SRS) is an end-of-pipe industrial wastewater treatment facility, that uses precipitation and filtration which is the EPA Best Available Technology economically achievable for a Metal Finishing and Aluminum Form Industries. The LETF consists of three close-coupled treatment facilities: the Dilute Effluent Treatment Facility (DETF), which uses wastewater equalization, physical/chemical precipitation, flocculation, and filtration; the Chemical Treatment Facility (CTF), which slurries the filter cake generated from the DETF and pumps it to interim-StatuS RCRA storage tanks; and the Interim Treatment/Storage Facility (IT/SF) which stores the waste from the CTF until the waste is stabilized/solidified for permanent disposal, 85% of the stored waste is from past nickel plating and aluminum canning of depleted uranium targets for the SRS nuclear reactors. Waste minimization and filtration efficiency are key to cost effective treatment of the supernate, because the waste filter cake generated is returned to the IT/SF. The DETF has been successfully optimized to achieve maximum efficiency and to minimize waste generation.

55 BIOMEDICAL SCIENCES, BASIC STUDIES

5501 Behavioral Biology

24839 (EGG–101617-2164) **San Joaquin kit fox (Vulpes velox macrotis) program, Camp Roberts, California: Progress report, fiscal years 1991–1992.** EG and G Energy Measurements, Inc., Goleta, CA (United States). Santa Barbara Operations. Oct 1992. 47p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract AC08-88NV10617. Order Number DE93013403. Source: OSTI; NTIS; GPO Dep.

Military training activities, new construction projects, and routine repair and maintenance activities conducted at Camp Roberts could adversely affect the endangered San Joaquin kit fox population. The Endangered Species Act of 1973 (as amended) states that all Federal agencies are to ensure that any actions authorized, funded, or carried out by the agency are not likely to have any detrimental effects on endangered species or their habitat. The major objective of the Camp Roberts Environmental Studies Program was to prepare a comprehensive Biological Assessment of the effects of all NGB-authorized activities on San Joaquin kit fox (military training, anticipated construction projects, repair and maintenance activities, and all NGB-authorized non-military activities such as a hunting and fishing program, grazing leases, etc.). The program also provided NGB with the scientific expertise necessary to ensure compliance with the Endangered Species Act. The objective of this report is to summarize the progress and results of the Environmental Studies Program during Fiscal Years 1991 and 1992 (FY91/92).

5502 Biochemistry

Refer also to citation(s) 22720, 23195, 23196, 23197, 23259, 23262, 24580, 24726, 24850, 24852, 24858, 24872, 24927

24840 (DOE/ER/13734–4) **[The first steps of chlorophyll synthesis: RNA involvement and regulation]: Progress report, January 1990–June 1992.** Soell, D. Yale Univ., New Haven, CT (United States). 1992. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-87ER13734. Order Number DE93014398. Source: OSTI; NTIS; GPO Dep.

Glu-tRNA^{Glu} is synthesized from glutamate and tRNA^{Glu} by glutamyl-tRNA synthetase (GluRS). Recent work has demonstrated that Glu-tRNA^{Glu} has dual functions and is a precursor for protein and 5-aminolevulinate (ALA) synthesis. Current data does not provide compelling evidence for the notion that GluRS is regulated by chlorophyll precursors or in concert with the other enzymes of ALA synthesis. We have redefined the C5-pathway as a two-step route to ALA starting with Glu-tRNA^{Glu}. Only two enzymes, Glu-tRNA reductase (GluTR) and GSA-2,1-amino-mutase (GSA-AM), are specifically involved in ALA synthesis. We have purified these enzymatic activities from Chlamydomonas and demonstrated that the two purified proteins in the presence of their cofactors NADPH and pyridoxal phosphate are sufficient for the in vitro Glu-tRNA → ALA conversion. We have cloned the genes encoding GluTR. The sequences of the GluTR proteins deduced from these genes share highly conserved regions with those of bacterial origin. We havealso cloned and analyzed the gene encoding GSA-AM from Arabidopsis. As in Salmonella typhimurium, there are indications of the existence of an additional pathway for ALA formation in E. coli. To shed light on the recognition of the single tRNA^{Glu} by the chloroplast enzymes GluTR, GluRS we characterized a chlorophyll-deficient mutant of Euglena having tRNA^{Glu} with a point mutation

in the TΨC-loop. The altered tRNA supports protein but not ALA synthesis.

24841 (DOE/ER/13810–6) **The center for plant and microbial complex carbohydrates at the University of Georgia Complex Carbohydrate Research Center: Five-year report, September 15, 1987–December 31, 1992.** Albersheim, P.; Darvill, A. Georgia Univ., Athens, GA (United States). Complex Carbohydrate Research Center. May 1992. 164p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG09-87ER13810. Order Number DE93015589. Source: OSTI; NTIS; GPO Dep.

The Complex Carbohydrate Research Center (CCRC) is the home of ten independent but complementary interdisciplinary research groups led by nine regular faculty and one adjunct faculty. The research of these groups represents a broad spectrum of interests, and they are involved in about 90 collaborations with their CCRC and UGA colleagues and with scientists at other institutions and companies in the US, Canada, Europe, Israel, and Japan. The hallmark of the CCRC is the collaborative, interactive environment encouraged by its directors, faculty and tong-term staff. Newcomers to the CCRC or short-term members soon learn that everyone benefits from this process. The team-oriented approach in carbohydrate science translates into the day-today generous giving of one's time and expertise to the work of others, whether it be in sharing specialized instrumentation, participating in the design of experiments and interpretalon of data, providing service to scientists outside the CCRC, or joining collaborative projects. The CCRC is founded on the principle that the cross-fertilization of ideas and know-how leads to the synergisfic advancement of science. This report contains a series of appendices that document the extent and breadth of the Plant and Microbial Carbohydrate Center's contributions to collaborative research, training, and sen m. Several collaborative research projects that have received postdoctoral research associate support from the Grant are highlighted below, as these projects are particularly illustrative of the wide-ranging collaborations that have evolved as a result of this Grant and the quality of the science that the Grant enables. Each of the projects receives support from other grants. In each of the four sections below, we include the scientific background of the projects, our accomplishments to date, and our current and proposed activities.

24842 (DOE/ER/13909–3) **[Characterization of a putative S locus encoded receptor protein kinase and its role in self-incompatibility]: Progress report, January 1993.** Cornell Univ., Ithaca, NY (United States). 1993. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-88ER13909. Order Number DE93013987. Source: OSTI; NTIS; GPO Dep.

The serine/threonine protein kinase (SRK) protein was predicted to be similar to the growth factor receptor tyrosine kinases in animals but its amino acid sequence of the catalytic domain is more similar to that of the catalytic domains of protein serine/threonine kinases than to protein tyrosine kinases. We have shown that the SRK protein has intrinsic scrine/threonine kinase activity. We subcloned the protein kinase-homologous domain of the SRK_6 cDNA into the bacterial expression vector pGEX-3X and we have constructed a second plasmid identical to the first except that it carried a conservative mutation that substituted Arg for the Lys^{524} codon of SRK6 This lysine corresponds to the ATP-binding site, is essential in protein kinases, and is a common target for site-directed mutagenesis as a means to obtain kinase-defective proteins. Cultures bearing the wild-type and mutant SRK catalytic domains each produced an approximately 64 kD protein that reacted with anti-SRK6 antibodies. Following pulse-labeling with ^{32}P we found that the wild-type SRK6 protein but not the mutant form was detectably phosphorylated. Phosphoamino acid analysis of the affinity purified ^{32}p-labeled GST-SRK6 fusion protein demonstrated that SRK was phosphorylated predominantly on semine and to a lesser extent on threonine, but not on tyrosine. Thus, SRK6 is a functional serine/threonine protein kinase.

24843 (DOE/ER/13970–4) **CarbBank: A structural and bibliographic database for complex carbohydrates: Progress report, September 15, 1991–September 14, 1992.** Albersheim, P. Georgia Univ., Athens, GA (United States). Complex Carbohydrate Research Center. Jun 1992. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG09-88ER13970. Order Number DE93015582. Source: OSTI; NTIS; GPO Dep.

The CarbBank project has several key facets: building a computer database that presents carbohydrate sequence information derived from the published literature, programming to create computer applications that use the information in the database, creating software for multiple computer platforms, and distributing software to end users.

24844 (DOE/ER/14056–14) **Direct probing of chromatography columns by laser-induced fluorescence: Technical progress report, September 1, 1989–February 28, 1993.** McGuffin, V.L. Michigan State Univ., East Lansing, MI (United States). Dept. of Chemistry. 7 Dec 1992. 25p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-89ER14056. Order Number DE93015208. Source: OSTI; NTIS; GPO Dep.

This report summarizes the progress and accomplishments of this research project from September 1, 1989 to February 28, 1993. During this period, we have accomplished all of the primary scientific objectives of the research proposal: (1) constructed and evaluated a laser-induced fluorescence detection system that allows direct examination of the chromatographic column, (2) examined nonequilibrium processes that occur upon solute injection and elution, (3) examined solute retention in liquid chromatography as a function of temperature and pressure, (4) examined solute zone dispersion in liquid chromatography as a function of temperature and pressure, and (5) developed appropriate theoretical models to describe these phenomena. In each of these studies, substantial knowledge has been gained of the fundamental processes that are responsible for chromatographic separations. In addition to these primary research objectives, we have made significant progress in three related areas: (1) examined pyrene as a fluorescent polarity probe insupercritical fluids and liquids as a function of temperature and pressure, (2) developed methods for the class-selective identification of polynuclear aromatic hydrocarbons in coal-derived fluids by microcolumn liquid chromatography with fluorescence quenching detection, and (3) developed methods for the determination of saturated and unsaturated (including omega-3) fatty acids in fish oil extracts by microcolumn liquid chromatography with laser-induced fluorescence detection. In these studies, the advanced separation and detection techniques developed in our laboratory are applied to practical problems of environmental and biomedical significance.

24845 (DOE/ER/20050–2) **Calmodulin immunolocalization to cortical microtubules is calcium independent.** Fisher, D.D.; Cyr, R.J. Pennsylvania State Univ., University Park, PA (United States). Dept. of Biology. [1992]. 36p. Sponsored by USDOE, Washington, DC (United States); Department of Agriculture, Washington, DC (United States). DOE Contract FG02-91ER20050. Order Number DE93015098. Source: OSTI; NTIS; GPO Dep.

Calcium affects the stability of cortical microtubules (MTs) in lysed protoplasts. This calmodulin (CaM)-mediated interaction may provide a mechanism that serves to integrate cellular behavior with MT function. To test the hypothesis that CaM associates with these MTs, monoclonal antibodies were produced against CaM, and one (designated mAb1D10), was selected for its suitability as an immunocytochemical reagent. It is shown that CaM associates with the cortical Mats of cultured carrot (Daucus carota L.) and tobacco (Nicotiana tobacum L.) cells. Inasmuch as CaM interacts with calcium and affects the behavior of these Mats, we hypothesized that calcium would alter this association. To test this, protoplasts containing taxol-stabilized Mats were lysed in the presence of various concentrations of calcium and examined for the association of Cam with cortical Mats. At 1 μM calcium, many protoplasts did not have CaM in association with the cortical Mats, while at 3.6 μM calcium, this association was completely abolished. The results are discussed in terms of a model in which CaM associates with Mats via two types of interactions; one calcium dependent and one independent.

24846 (DOE/ER/20050–T1) **Role of Ca^{++}/calmodulin in the regulation of microtubules in higher plants: Progress report, FY 1992.** Cyr, R. Pennsylvania State Univ., University Park, PA (United States). Dept. of Biology. [1992]. 7p. Sponsored by

USDOE, Washington, DC (United States). DOE Contract FG02-91ER20050. Order Number DE93015885. Source: OSTI; NTIS; GPO Dep.

The cytoskeleton including its microtubule (Mt) component participates in processes that directly affect growth and development in higher plants. Normal cytoskeletal function requires the precise and orderly arrangement of Mts into several cell cycle and developmentally specific arrays. The cortical array somehow directs the deposition of cellulose. Little molecular information is available regarding the formation of these arrays or the cellular signals to which they respond. Experimental data described here suggests that plant cells use calcium, in the form of a Ca^{++}/calmodulin complex, to affect the dynamics of Mts within the cortical array. Owing to the importance of Ca^{++} as a regulatory ion in higher plants we are probing for a putative Ca^{++}/Mt transduction pathway which may serve to integrate Mt activities within the growing and developing plant cell. We are using a lysed cell model in conjunction with immunocytochemical and biochemical methodologies to dissect how Ca^{++}/calmodulin interacts with Mts to affect their function.

24847 (DOE/FTR–4349) **[Travel to Turin, Italy, to attend and participate in an international workshop entitled "Biological sequences: Finding structure and function by neural networks"]: Foreign trip report, June 29, 1992–July 15, 1992.** Mural, R.J. Oak Ridge National Lab., TN (United States). 30 Jul 1992. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93012772. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The problem of identifying biologically meaningful patterns in the sequences of biological macromolecules, such as DNA and proteins, has taken on increased significance because of the very large amount of primary sequence data which has been generated over the last several years. The techniques of neural network computing provide a powerful tool for pattern recognition in general and have shown promising results when applied to biological sequences. The workshop "Biological Sequences: Finding Structure and Function by Neural Networks" brought together 23 investigators whose work focuses on finding patterns in biological sequences. The traveler presented a paper entitled "Combing neural networks and expert systems to identify features in DNA sequences" at this workshop.

24848 (ETDE/ES-mf–93796608) **The Keratin 6 gene family: Charaterization and regulation.** Navarro Espinel, J.M. (Universidad Complutense de Madrid. Dept. Biologia (Spain)). Universidad Complutense de Madrid (Spain). Dept. de Fisica Atomica, Molecular y Nuclear. 1992. 117p. (In Spanish). Order Number DE93796608. Source: OSTI; NTIS.

Cytokeratins are a family of ca. 30 proteins that are expressed exclusively in epithelial cells, where they constitute the intermediate filaments cytoskeleton. Keratin 6 is expressed in some tissues (tongue, esophagus, foot sole epidermis, etc.), as well as in the suprabasal layers of epidermis under hyperproliferative stimuli, such as tpa, wound healing, etc. In addition, it is expressed in most cultured epidermal cells lines. We have found that there are three different genes coding for similar-but not identical-k6 polypeptides in the cow. We have used CAT assays, gel retardation and footprinting techniques to analyze the promoter of one of the genes in several cell lines and have found two elements implicated in the regulation of this gene. One of them is a AP1-like site and the other seems to be a retinoic-acid responsive element. Implications of these findings for the regulation of the K6 gene are discussed. (author).250 refs, 48 figs.

24849 (ETDE/ES-mf–93796609) **Antisense RNA: a genetic approach to cell resistance against Parvovirus.** Ramirez Martinez, J.C. Universidad Autonoma de Madrid (Spain). Facultad de Ciencias Fisicas. 1992. 100p. (In Spanish). Order Number DE93796609. Source: OSTI; NTIS.

The Minute Virus of Mice (MVMp), an autonomous Parvovirus that replicates cytolytically in the A9 mouse fibroblast cell line, was interfered by constitutive expression of an antisense RNA targeted against the major non-structural NS-1 protein. Permanently transfected A9 clones expressing NS-1 antisense, showed increased proliferative capacity upon virus infection, and likewise cultures infected at low multiplicity by MVMp reached confluence overcoming virus growth. Correspondingly, an inhibition in virus multiplication was demonstrated by a significant lower virus production and plaque forming ability in clones expressing antisense RNa. At the molecular level, several fold reduction in viral DNA, RNA and proteins was quantitated by respective analysis of Southern, RNase protection and bidimensional gels. Remarkably, the accumulation of all three viral messengers(R1,R2,R3) was decreased both in the cytoplasm and in the nucleus, suggesting that antisense-mediated inhibition is primarily exerted at the level of viral transcription or nuclear post-transcriptional events. Thus, this system illustrates the possibility to create an antisense-mediated protective stage to highly cytotoxic viruses in permissive cells, by down-modulation the expression of a transactivator of virus genes. (author)180 refs., 25 figs.

5503 Cytology

Refer also to citation(s) 24845

5504 Genetics

Refer also to citation(s) 22723, 24847, 24848, 24849

24850 (DOE/ER/60692–5) **Mapping and ordered cloning of the human X chromosome: Progress report, September 1991–November 1992.** Caskey, C.T.; Nelson, D.L. Baylor Univ., Houston, TX (United States). Inst. of Molecular Genetics. Dec 1992. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG05-88ER60692. Order Number DE93015072. Source: OSTI; NTIS; GPO Dep.

Progress is reported on gathering X chromosome specific libraries and integrating those with the library produced in this project. Further studies on understanding Fragile X Syndrome and other hereditary diseases related to the X chromosome are described. (DT)

24851 (DOE/ER/60851–4) **Field-flow fractionation of chromosomes: Final technical report, July 1, 1989–January 31, 1993.** Giddings, J.C. Utah Univ., Salt Lake City, UT (United States). Apr 1993. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-89ER60851. Order Number DE93015094. Source: OSTI; NTIS; GPO Dep.

The first topic of this project involved the preparation, fractionation by sedimentation/steric Field Flow Fractionation (FFF), and modeling of metaphase chromosomes. After numerous unsuccessful attempts to prepare chromosomes, we have implemented a procedure (in collaboration with Los Alamos National Laboratory) to prepare metaphase chromosomes from Chinese hamster cells. Extensive experimentation was necessary to identify a suitable FFF channel surface to minimize chromosome adsorption and a carrier liquid to stabilize and disperse the chromosomes. Under suitable operating conditions, the Chinese hamster chromosomes were purified from cell debris and partially fractionated. The purified, preenriched chromosomes that can be prepared by sedimentation/steric FFF or produced continuously by continuous SPLITT fractionation provide an enriched feed material for subsequent flow cytometry. In the second project component, flow FFF permitted successful separations of single- from double-stranded circular DNA, double-stranded circular DNAs of various sizes, and linear double-stranded DNA fragments of various lengths. Diffusion coefficients extracted from retention data agreed well with literature data as well as predictions of major polymer theories. The capacity of FFF separations was evaluated to examine potential applications to long DNA chains.

24852 (LA-UR–93-1647) **Genetic algorithms for DNA sequence assembly.** Parsons, R. (Los Alamos National Lab., NM (United States)); Burks, C.; Forrest, S. Los Alamos National Lab., NM (United States). 13 Apr 1993. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930745–1: 1. international conference in intelligent systems for molecular biology, Washington, DC (United States), 7-9 Jul 1993). Order Number DE93012708. Source: OSTI; NTIS; GPO Dep.

This paper describes a genetic algorithm application to the DNA fragment assembly problems. The genetic algorithm uses a

random key representation for representing the orderings of fragments. Two different fitness functions, both based on pairwise overlap strengths between fragments, were tested. The paper concludes that the genetic algorithm is a promising method for fragment assembly problems, achieving usable solutions quickly, but that the current fitness functions are flawed and that other representations might be more appropriate.

24853 (UCRL-ID–111825) **Dose-to-risk conversion factors for low-level tritium exposures.** Straume, T. Lawrence Livermore National Lab., CA (United States). 10 Sep 1992. 20p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE93009444. Source: OSTI; NTIS; INIS; GPO Dep.

During the past decade, a large number of radiobiological studies have become available for tritium-many of them focusing on the relative biological effectiveness (RBE) of tritium beta rays. These and previous studies indicate that tritium in body water produces the same spectrum of radiogenic effects, e.g., cancer, genetic effects, developmental abnormalities, and reproductive effects, observed following whole-body exposure to penetrating radiations such as gamma rays and x rays. The only significant difference in biological response between tritium beta-rays and the other common low linear-energy transfer (LET) radiations, such as gamma rays and x rays, appears to be the greater biological effectiveness of tritium beta rays. For example, tritium in the oxide form (HTO) is about 2 to 3 times more effective at low doses or low dose rates than gamma rays from ^{137}Cs or ^{60}CO (Straume, 1991). When tritium is bound to organic molecules, RBE values may be somewhat larger than those for HTO. It is now clear from the wealth of tritium data available that RBEs for tritium beta rays are higher than the quality factor of unity generally used in radiation protection.

24854 (UCRL-JC–111419) **Livermore's pragmatic approach to integrated mapping for chromosome 19.** Slezak, T.; Wagner, M.; Yeh, M.; Cantu, R. III; Branscomb, E. Lawrence Livermore National Lab., CA (United States). 15 Jul 1992. 23p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9207189–1: Computational methods in genome research conference, Heidelberg (Germany), 1-4 Jul 1992). Order Number DE93011875. Source: OSTI; NTIS; GPO Dep.

For several years Livermore has been using a bottom-up approach to physical mapping, constructing contigs from cosmid clone fingerprints. We currently have 7112 clones placed in 854 contigs and now are using various other means to close gaps, complete, and verify the map. This has required us to develop an information model capable of handling all the important relationships between any "mappable object" and producing a variety of ways of visualizing this integrated data. We have defined a set of relations on a single generic map object class that allows us to distill all the distance/order/orientation/overlap/etc. data contained in our underlying database, along with algorithms to construct partial order trees and display the integrated results in our X-windows database browser tool. This system uses Sybase/SQL/Unix/C and can be used on Sun color Sparcstations with Internet access. We currently have SQL access to the GDB and GenBank database servers but are not yet extracting relevant data from these sources into our integrated map except through our direct collaborative orations with data submitters.

5505 Metabolism

Refer also to citation(s) 22845, 24717, 24725, 24858, 24928

5506 Medicine

Refer also to citation(s) 24452, 24455, 24458, 24459, 24461, 24868, 24890, 24897, 24911, 25187

24855 (BNL–48454) **CT imaging of small animals using monochromatized synchrotron x rays.** Dilmanian, F.A. (Brookhaven National Lab., Upton, NY (United States)); Rarback, H.; Nachaliel, E.; Rivers, M.; Thomlinson, W.C.; Chapman, L.D.; Oversluizen, T.; Slatkin, D.N.; Spanne, P.; Spector, S.; Garrett, R.F.; Luke, P.N.; Pehl, R.; Thompson, A.C.; ApBrookhaven National Lab., Upton, NY (United States). [1992]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-921005–30: Institute of Electrical and Electronic Engineers (IEEE) nuclear science symposium and medical imaging conference, Orlando, FL (United States), 26-31 Oct 1992). Order Number DE93009329. Source: OSTI; NTIS; GPO Dep.

Rats and chicken embryos were imaged in vivo with a prototype Multiple Energy Computed Tomography (MECT) system using monochromatized x rays from the X17 superconducting wiggler at the National Synchrotron Light Source. The CT configuration coated of a horizontal low-divergence, fan-shaped beam, 70 mm wide and 0.5 mm high, and a subject rotating about a vertical aids. A linear-array high-purity Ge detector with 140 elements, each 0.5 mm wide and 6 mm thick, was used with a data acquisition system that provides a linear response over almost six orders of magnitude of detector current. The dual photon absorptiometry (DPA) algorithm was applied to images of the rat head acquired at 20 and 45 keV to obtain two new images, one representing the low-Z, and the other the intermediate-Z clement group. The results indicate that the contrast resolution and the quantification accuracy of the images improve stepwise; first, with the monochromatic beam and, second, the DPA method. The system is a prototype for a brain scanner.

24856 (DOE/ER/60487–7) **Development of more efficacious T_c-99m organ imaging agents for use in nuclear medicine by analytical characterization of radiopharmaceuticals: Annual technical progress report, September 1, 1992–August 31, 1993.** Heineman, W.R. Cincinnati Univ., OH (United States). Dept. of Chemistry. 3 May 1993. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-86ER60487. Order Number DE93014435. Source: OSTI; NTIS; INIS; GPO Dep.

This research program is detailed at development of more efficacious technetium-99m radiopharmaceuticals for use as imaging agents in diagnostic nuclear medicine. We seek to isolate and develop distinct site imaging agents to provide diagnostic information concerning a given pathological condition. Analytical techniques are being developed to enable complete analysis of radiopharmaceutical preparations so that individual complexes can be characterized with respect to imaging efficacy and to enable a radiopharmaceutical to be monitored after injection into a test animal to determine the species that actually accumulates in an organ to provide the image. Administration of the isolated, single most effective imaging complex, rather than a mixture of technetium-containing complexes, wi-11 minimize radiation exposure to the patient and maximize diagnostic information available to the clinician. This report specifically describes the development of capillary electrophoresis (CE) for characterizating diphosphonate skeletal imaging agents. Advances in the development of electrochemical and fiber optic sensors for Tc and Re imaging agents are described. These sensors will ultimately be capable of monitoring a specific chemical state of an imaging agent in vivo after injection into a test animal by implantation in the organ of interest.

24857 (DOE/ER/60561–8) **New techniques for positron emission tomography in the study of human neurological disorders: Progress report, June 1990–June 1993.** Kuhl, D.E. Michigan Univ., Ann Arbor, MI (United States). Div. of Nuclear Medicine. [1993]. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-87ER60561. Order Number DE93014439. Source: OSTI; NTIS; GPO Dep.

This progress report describes accomplishments of four programs. The four programs are entitled (1) Faster,simpler processing of positron-computing precursors: New physicochemical approaches, (2) Novel solid phase reagents and methods to improve radiosynthesis and isotope production, (3) Quantitative evaluation of the extraction of information from PET images, and (4) Optimization of tracer kinetic methods for radioligand studies in PET.

24858 (DOE/ER/61033–3) **Scintillation materials for medical applications: Annual progress report, January 1, 1991–December 31, 1992.** Lempicki, A.; Wojtowicz, A.J. Boston Univ., MA (United States). [1992]. 6p. Sponsored by USDOE,

Washington, DC (United States). DOE Contract FG02-90ER61033. Order Number DE93015356. Source: OSTI; NTIS; GPO Dep.

Scintillators are beginning to attract renewed attention because modern High Energy Physics accelerators are placing unprecedented demands of quantity and quality of detector materials and Positron Emission Tomography (PET), used by the medical field. Both applications required materials for scintillator detectors with properties beyond those delivered by traditional scintillators. Thallium doped halides are very efficient, but slow and chemically unstable. Two modern developments, namely the very fast BaF_2, which owed its success to the newly discovered crossover transitions, and CeF_3, which carried a promise of fast components, more practical wavelengths and attractive efficiency. Since traditional scintillators (Tl doped halides) are very efficient, and could be even more efficient at larger concentrations of Tl, if it were not for concentration quenching. However Tl transitions are spin forbidden and slow. Both ills could be remedied by replacing Tl with Ce, whose transitions are allowed and which is known to form fully concentrated compounds of high photoluminescent efficiency and no quenching. These materials, plus new Ce-doped materials, exhibiting highly promising properties for medical applications, became the target of our studies.

24859 (DOE/FTR–93011413) **Travel to Russia to access the proton therapy and channeling facilities: Foreign trip report, October 2–13, 1992.** Carrigan, R. Fermi National Accelerator Lab., Batavia, IL (United States). 21 Nov 1992. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03000. Order Number DE93011413. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This travel report addresses the economic plight of investigators with whom the traveler has previous and continuing relationship concerning proton therapy in the Russian Federation. (DT)

24860 (FNAL/C–93/077) **Neutron sources for a neutron capture therapy facility.** Lennox, A.J. Fermi National Accelerator Lab., Batavia, IL (United States). Apr 1993. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03000. (CONF-930168–5: Simulating accelerator radiation environments workshop, Santa Fe, NM (United States), 11-15 Jan 1993). Order Number DE93011887. Source: OSTI; NTIS; GPO Dep.

Recent advances in the development of boron pharmaceuticals have reopened the possibility of using epithermal neutrons to treat brain tumors containing boron-10. This paper summarizes the approaches being used to generate the neutron sources and identifies specific areas where more research and development are needed.

24861 (INDC(NDS)–203/GZ) **Nuclear data needed for neutron therapy: Summary report of the 1. research co-ordination meeting held in Vienna, 17-20 November 1987.** Okamoto, K. (ed.) (International Atomic Energy Agency, Vienna (Austria). Nuclear Data Section). International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Mar 1988. [18p.] (CONF-8711365–: 1. research co-ordination meeting on nuclear data needed for neutron therapy, Vienna (Austria), 17-20 Nov 1987). Order Number DE93626071. Source: OSTI; NTIS (US Sales Only); INIS.

This is the summary report of the First Research Co-ordination Meeting of the IAEA Co-ordinated Research Programme (CRP) on Nuclear Data Needed for Neutron Therapy, convened by the IAEA Nuclear Data Section in Vienna, from 17 to 20 November 1987. The main objectives of the CRP are to improve the present state of nuclear data for neutron therapy. (author).

24862 (INDC(NDS)–216/GZ) **Nuclear data needed for neutron therapy: Summary report of the 2. research co-ordination meeting held in Vienna, 24-27 January 1989.** Okamoto, K. (ed.) (International Atomic Energy Agency, Vienna (Austria). Nuclear Data Section). International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Mar 1989. [35p.] (CONF-8901230–: 2. research co-ordination meeting on nuclear data needed for neutron therapy, Vienna (Austria), 24-27 Jan 1989). Order Number DE93626072. Source: OSTI; NTIS (US Sales Only); INIS.

The Second Research Co-ordination Meeting (RCM) of the IAEA Co-ordinated Research Programme (CRP) on Nuclear Data Needed for Neutron Therapy was convened by the IAEA Nuclear Data Section, in Vienna, from 24 to 27 January 1989. The Summary Report of the First RCM was issued as INDC(NDS)-203/GZ (March 1988). Special emphasis was put on the discussion of the issue of the final publication of this CRP. (author). 36 refs, 8 tabs.

24863 (INDC(NDS)–216/GZ, pp. 7-24) **Present status of fast neutron therapy survey of the clinical data and of the clinical research programmes.** Wambersie, A. (Louvain Univ., Brussels (Belgium). Cliniques Universitaires St. Luc); Richard, F. International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Mar 1989. (CONF-8901230–: 2. research co-ordination meeting on nuclear data needed for neutron therapy, Vienna (Austria), 24-27 Jan 1989). In *Nuclear data needed for neutron therapy: Summary report of the 2. research co-ordination meeting held in Vienna, 24-27 January 1989.* [35p.] Order Number DE93626072. Source: OSTI; NTIS (US Sales Only); INIS.

The clinical results reported from the neutron therapy centers in USA, Europe and Asia are reviewed. Fast neutrons are shown superior to photons for locally extended inoperable salivary gland tumors with overall local control rates are 67% verses 24%. Paranasal sinuses and some tumors of the head and neck area, especially extended tumors with large fixed lymph nodes, are also indications for neutrons. By contrast, the results obtained for brain tumors were, in general, disappointing. Neutrons were shown to bring a benefit in the treatment of well differentiated slowly growing soft tissue sarcomas. The reported overall local control rates were 53% and 38% after neutron and photon irradiation respectively. Better results, after neutron irradiation, were also reported for bone- and chondrosarcomas. The reported local control rates are 54% for osteosarcomas and 49% for chondrosarcomas after neutron irradiation; the corresponding values are 21% and 33% respectively after photon irradiation. For locally extended prostatic adenocarcinoma, the superiority of mixed schedule (neutrons + photons) was demonstrated by a RTOG randomized trial (local control rates 77% for mixed schedule compared to 31% for photons). Neutrons were also shown to be useful for palliative treatment of melanomas. Further studies are needed in order to definitively evaluate the benefit of fast neutrons for other areas such as uterine cervix, bladder, and rectum. It can be concluded that fast neutrons are superior to photons for at least 10% to 20% of the radiotherapy patients. While it is recognized that the first patient series were treated under suboptimal conditions, recent improvements have been made using high-energy hospital-based cyclotrons fully dedicated to neutron therapy. 36 refs, 8 tabs.

24864 (INDC(NDS)–217/GZ, pp. 15-40) **The future of high-let radiation in cancer therapy. Justification of the heavy-ion therapy programmes.** Wambersie, A. (Louvain Univ., Brussels (Belgium). Cliniques Universitaires St. Luc). International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Mar 1989. (CONF-8901231–: 1. research co-ordination meeting on atomic and molecular data for radiotherapy, Vienna (Austria), 30 Jan - 2 feb 1989). In *Atomic and molecular data for radiotherapy: Summary report of the 1. research co-ordination meeting, Vienna, 30 January - 2 February.* [54p.] Order Number DE93626073. Source: OSTI; NTIS (US Sales Only); INIS.

The introduction of new types of ionizing radiations to control the primary tumour is a promising approach in radiation therapy. High-LET (linear energy transfer) radiations produce different biological effects compared to conventional X-rays, leading to a potential therapeutic advantage over low-LET (e.g., protons or helium ions) beams, which only are aimed at improving the physical selectivity. Introduced historically to reduce the OER (oxygen enhancement ratio), there is evidence for a reduction in radiosensitivity differences, which implies an advantage or disadvantage depending on the tumour characteristics and the normal tissues at risk, which in turn raises the problem of patient selection. From clinical data, fast neutrons were found to be superior to photons in the treatments of salivary gland tumours, prostatic adenocarcinomas, and some carcinomas. Heavy ions combine the advantages of a high physical selectivity and the potential advantage of high-LET for some tumour types. Clinical indications for the use of heavy-ion beams are therefore those tumours that reside in problematic sites but are of a type for which high-LET radiations were already shown to be

useful. This review discusses the improvement of the physical selectivity with proton and helium ion beams; the differential effect and the potential advantage of neutrons and high-LET radiations (including both the radiological considerations and the clinical data); and presents the rationale for heavy-ion therapy. 38 refs, 7 figs, 10 tabs.

24865 (PTB-Dos–21, pp. 112-122) **Dosimetry at the patient as a central task of quality assurance in radiotherapy.** Nuesslin, F. (Radiologische Universitaetsklinik, Tuebingen (Germany). Abt. fuer Medizinische Physik). Physikalisch-Technische Bundesanstalt, Braunschweig (Germany). Dosimetrie. Aug 1992. (In German). (CONF-9111318–: 95. PTB seminar 'Dose measurement techniques for high-energy photon and electron radiation', Braunschweig (Germany), 11-12 Nov 1991). In *Dose measurement techniques for high-energy photon and electron radiation. Proceedings.* 127p. Order Number DE93796871. Source: OSTI; NTIS (US Sales Only); INIS.

Guided by the ICRU concept, first of all the requirements on the accuracy of dose determination resulting from clinical observations (dose-response relationship) are dealt with. On average a total uncertainty (1 standard deviation) of dose determination of 3.5% has to be sought. In four steps - dosimetry, simulation/localization, dose planning and irradiation - the respective dose uncertainties are estimated and illustrated by examples. The result obtained by square error addition, of a total uncertainty of 8% (1 standard deviation) is contrasted with multi-centric reference actions with phantom irradiations. It shows that the accuracy requirement of 5% on dosimetry in clinical routine is not easy to achieve. (orig.).

5507 Microbiology

Refer also to citation(s) 22658, 22718, 22740, 22845, 23819, 24104, 24658, 24728, 24729, 24783, 24827

24866 (DOE/ER/13361–T4) **Summer investigations into the metabolic diversity of the microbial world: Progress report, May 5, 1992–April 30, 1993.** Breznak, J.; Dworkin, M. Marine Biological Lab., Woods Hole, MA (United States). 17 May 1993. 20p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-85ER13361. Order Number DE93014837. Source: OSTI; NTIS; GPO Dep.

The philosophy of the course described here is to underscore the essence of microbiology which is diversity>: diversity of morphology and cellular development, behavior, and metabolic and physiological functions. Emphasis is on microbes other than those customarily covered in conventional microbiology courses and includes: the archaebacteria, extremophiles, and array of obligate anaerobes, various phototrophs, and those microbes exhibiting complex developmental cycles. Also included are microbes carrying out a variety of transformations of organic and inorganic compounds, as well as those which normally occur in symbiotic association with other microbes or with higher forms of life.

5509 Pathology

Refer also to citation(s) 24933

5510 Physiological Systems

Refer also to citation(s) 24724, 24842, 24867

5520 Public Health

Refer also to citation(s) 23819, 24853, 24911

5530 Agriculture and Food Technology

Refer also to citation(s) 23190, 23262, 23278, 23885, 24786, 24909

24867 (BNL–70218) **[Travel to attend the biennial meeting of the Federation of European Societies of Plant Physiology, Antwerpen, Belgium]: Foreign trip report, August 21, 1992–September 12, 1992.** Long, S.P. Brookhaven National Lab., Upton, NY (United States). 17 Sep 1992. 25p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. Order Number DE93011932. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report describes traveler's involvement and impressions of travel while attending the biennial meeting of the Federation of European Societies of Plant Physiology, Antwerpen, Belgium and of the 8th International Congress on Photosynthesis Research, Nagoya, Japan. Participation in United Nations Environment Program review of its Project on Primary Production and Photosynthesis in Tropical Grasslands, London, England is described.

24868 (IAEA-TC-PM–003) **Country programme review. United Republic of Tanzania.** Cuaron, A.; Hance, R.; Yurtsever, Y.; Maudarbocus, V. International Atomic Energy Agency, Vienna (Austria). Div. of Technical Co-operation Programmes. 1992. [33p.] Project INT/0/053. Order Number DE93625781. Source: OSTI; NTIS (US Sales Only); INIS.

This document provides a review of past and present IAEA Technical Co-operation Activities in Tanzania and gives descriptions of the current status of nuclear applications in food and agriculture, human health, water resources and industrial applications/nuclear instrumentation.

24869 (ORNL/FTR–4564) **[Travel to England and Germany to discuss sustainable agriculture and global landscape change research]: Foreign trip report, March 10–21, 1993.** Honea, R.B. Oak Ridge National Lab., TN (United States). 29 Mar 1993. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93011814. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The traveler first visited England where the British Embassy in Washington arranged a visit to the remote sensing archives of the Royal Air Force at Huntingdon, England. Staff at the Joint Air Reconnaissance Intelligence Centre valuable information regarding the availability of imagery dating back to the 1920s. The most important discovery was a nearly complete aerial survey of Africa made soon after World War II. Informal agreements were made to pursue joint research on using these data for global. Following the visit to England, the Agriculture Counsular at the German Embassy in Washington, assisted in making arrangements to visit selected government officials to discuss the possibility of using the Tellow Estate of Johann Heinrich von Thunen as a demonstration site for sustainable agriculture. Thunen (1783–1850) was a famous agricultural economist known internationally for his theory explaining agricultural production and location. The Estate was presumed destroyed but was rediscovered after reunification. The possibility of using the estate as a demonstration site to aid in rebuilding East European countries was discussed with officials at the University of Rostock, local governments, and with the Ministry of Agriculture. All agreed that pending funds and interest within the scientific community, every effort should be made to preserve the Estate as a demonstration farm and eventually convert the facility into a research institute.

56 BIOMEDICAL SCIENCES, APPLIED STUDIES

5601 Radiation Effects

Refer also to citation(s) 23060, 23087, 23109, 23110, 23111, 23112, 23113, 23114, 23115, 23116, 23117, 23118, 23119, 23120, 23121, 23122, 23123, 23124, 23125, 23126, 23140, 23144, 23545, 23811, 24069, 24179, 24452, 24453, 24454, 24455, 24456, 24457, 24458, 24459, 24460, 24461, 24578, 24720, 24759, 24761, 24853, 24864, 24865, 25187

24870 (BfS-ISH–150/91) **Value and reliability of findings from previous epidemiologic studies in the assessment of radiation-related cancer risks. Pt. 3. Radiation-related risk of the breast.** Frasch, G.; Martignoni, K. Bundesamt fuer Strahlenschutz, Neuherberg (Germany). Inst. fuer Strahlenhygiene; Bundesministerium fuer Umwelt, Naturschutz und Reaktorsicherheit, Bonn (Germany). Jan 1990. 68p. (In German). Contract BMU

St.Sch. 960. Order Number DE93792572. Source: OSTI; NTIS (US Sales Only); INIS.

The theories put forward here are predominantly based on pooled data from previous studies in a number of cohorts made up by mostly non-average individuals. These studies were carried out by various researchers and differed in procedures and aims. Factors of major importance to the validity and reliability of the conclusions drawn from this study are pointed out. In one chapter some light is thrown on factors known to bear a relation to the incidence of radiation-induced cancer of the breast, even though at present this can only very vaguely be described on a quantitative basis. These factors include fractionated dose regimens, pregnancies and parturitions, menarche, menopause, synergisms as well as secondary cancer of the breast. The available body of evidence suggests that exposure of each of 1 million women to a dose of 10 mGy (rad) can be linked with approx. 3 additional cases of mammary cancer reported on an average per year after the latency period. The fact that there is some statistical scatter around this value is chiefly attributable to age-related causes at the beginning of exposure. Differences in ethnic and cultural characteristics between the populations investigated appeared to be less important here. (orig./MG).

24871 (BfS-ISH–157/92) **Gestations and parturitions after the Chernoby1 reactor accident. A representative evaluation for the Federal Republic of Germany and Berlin (West). Final report.** Hoeltz, J. (Infratest Gesundheitsforschung, Muenchen (Germany)); Hoeltz, A.; Potthoff, P.; Brachner, A.; Grosche, B.; Hinz, G.; Kaul, A.; Martignoni, K.; Roedler, H.D.; Schwarz, E.; Tsavachidis, C. Bundesamt fuer Strahlenschutz, Neuherberg (Germany). Inst. fuer Strahlenhygiene. Sep 1992. 317p. (In German). Order Number DE93791918. Source: OSTI; NTIS (US Sales Only); INIS.

In the Federal Republic of Germany (former states) a cohort study was performed to find out, if there were any untoward pregnancy outcomes (preterm births) after the Chernobyl accident. It was also investigated, whether a possibly increased incidence of premature births was correlated to fears of the pregnant women for increased radiation exposure. The study was carried out in 3 stages: In the first stage (card-file monitoring) the data of 5,548 pregnant women (date of conception between April and August 1986) were taken from their gynaecologists' card-files, and in stage 2 and 3 (questionnaire/pregnancy record monitoring) 3,946 pregnant women (date of conception between January 1987 and February 1988) additionally filled in an extensive questionnaire. The influence of the following risk factors was studied: fears, smoking, drug consumption, biomedical and socio-economic factors. Both, in the card-file monitoring and the questionnaire, there was no statistically significant difference in the rate of preterm births in areas with different radiation exposure. From women living in areas with higher radiation exposure due to the Chernobyl fallout fears related to environmental risks were mentioned more frequently. There was a statistically significant increase in premature births for the risk factors smoking, psycho-drug consumption, and for biomedical risks as documented in the pregnancy records. When comparing this study with a similar one from 1981/1982, no difference in the rate of preterm births was observed. (orig.).

24872 (BNL–48723) **Time sequence of events leading to chromosomal aberration formation.** Moore, R.C. (Peter MacCallum Cancer Inst., Melbourne, VIC (Australia)); Bender, M.A. Brookhaven National Lab., Upton, NY (United States). [1993]. 21p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-930295–2: 6. international environmental and molecular mutagenesis: the molecular basis of chromosomal aberrations, Castlemaine (Australia), 17-20 Feb 1993). Order Number DE93013339. Source: OSTI; NTIS; GPO Dep.

Investigations have been carried out on the influence of the repair polymerases on the yield of different types of chromosomal aberrations. The studies were mainly concerned with the effect of inhibiting the polymerases on the yield of aberrations. The polymerases fill in single-strand regions, and the fact that their inhibition affects the yield of aberrations suggests that single-strand lesions are influential in aberration formation. The results indicate that there are two actions of polymerases in clastogenesis. One is in their involvement in a G_2 repair system, in which either of the two chromatids is concerned, and which does not yield aberrations unless the inhibition is still operating when the cells enter mitosis. The second is such that when repair is inhibited, further damage accrues. The second action is affected by inhibiting polymerase repair, but also operates even when the repair enzymes are active. The production of chromosomal exchanges involves a series of reactions, some of which are reversible. The time span over which the reactions occur is much longer than has been envisaged previously.

24873 (BNL–48776) **Pilot study risk assessment for selected problems at the Savannah River Site (SRS).** Hamilton, L.D. (Brookhaven National Lab., Upton, NY (United States)); Holtzman, S.; Meinhold, A.; Morris, S.C.; Pardi, R.; Sun, C.; Daniels, J.I.; Layton, D.; McKone, T.E.; Straume, T.; Anspaugh, L. Brookhaven National Lab., Upton, NY (United States); Lawrence Livermore National Lab., CA (United States). Mar 1993. 82p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. Order Number DE93012520. Source: OSTI; NTIS; INIS; GPO Dep.

An assessment of the health risks was made for releases of tritium and ^{137}Cs from the Savannah River Site (SRS) at water-receptor locations downriver. Although reactor operations were shut down at the SRS in 1989, liquid wastes continue to be released to the Savannah River either by direct discharges into on-site surface waters or by groundwater transport into surface waters from waste facilities. Existing state mandates will cause the liquid waste streams from future operations to go directly into surface waters. Two drinking water processing plants take water from the river approximately 129 km downriver from the SRS. Potential incremental risks of cancer fatality to individuals and each population were analyzed for either no further reactor operations or resumption of operation of one specific reactor.

24874 (CNIC–00625) **The relationship between lymphocytes activated by pokeweed mitogen and by lipopolysaccharides and their radiosensitivity.** Su Liaoyuan (Suzhou Medical Coll. (China)); Liu Fenju; Liu Keliang; Xu Changshao; Xu Yingdong; Geng Yongzhi. China Nuclear Information Centre, Beijing, BJ (China). Jul 1992. [12p.] (SMC–0080.). Order Number DE93625665. Source: OSTI; NTIS (US Sales Only); INIS.

Human whole blood was incubated in vitro. Lymphocytes were activated by poke-weed mitogen (PWM) and by Lipopolysaccharides (LPS). The relationship between the two kinds of lymphocytes was investigated using radioactive compound incorporation. The study showed that PWM-activated lymphocytes were able to promote the stimulating effect of LPS on B lymphocytes. The stimulating effect of PWM-activated lymphocytes was obviously decreased after they were irradiated with 10 Gy gamma rays. When PWM-activated lymphocytes and LPS-activated lymphocytes were incubated together after one of the cell populations had been exposed 10 Gy ^{60}Co gamma rays, the incorporation of [^{3}H] TdR was much decreased and the synergistic function disappeared, especially when the PWM-activated lymphocytes were irradiated. In cells from patients treated with ^{60}Co gamma rays for carcinoma of nasopharynx, the incorporation in LPS-activated lymphocytes approached normal levels while that in PWM-activated lymphocytes was reduced significantly and the stimulating effect of PWM-activated lymphocytes on LPS-activated lymphocytes was also markedly reduced. These demonstrate that PWM-activated lymphocytes have a similar function to T-helper cells and seem to be more radiosensitive than LPS-activated lymphocytes.

24875 (CONF-900679–13) **Feasibility of nuclear quadrupole resonance as a novel dosimetry tool.** Iselin, L.H.; Hintenlang, D.E.; Epperson, S.J.; Higgins, G.A.; Jamil, K. Florida Univ., Gainesville, FL (United States). Dept. of Nuclear Engineering Sciences; Oak Ridge Associated Universities, Inc., TN (United States). [1990]. 14p. Sponsored by USDOE, Washington, DC (United States); Department of Defense, Washington, DC (United States). DOE Contract FG02-89ER12890 ;AC05-76OR00033. From 1990 Health Physics Society meeting; Anaheim, CA (United States); 24-28 Jun 1990. Order Number DE93010315. Source: OSTI; NTIS; INIS; GPO Dep.

Nuclear quadrupole resonance (N.Q.R) frequencies are influenced by the symmetry of the charge distribution of a compound

around the site of interest. Damage by ionizing radiation causes changes in this charge symmetry which can be detected by standard pulsed N.Q.R. methods. Previous work done on various chlorates of ^{35}Cl at room temperature (Vargas et al., 1978) shows a linear effect between absorbed gammadose and the N.Q.R. frequency shift and line broadening. This paper reviews the theory of N.Q.R. and details our experimental apparatus. The accumulated data on ^{14}N-containing compounds, both irradiated and nonirradiated, is discussed. The long term goal of this research is to choose an appropriate organic compound to duplicate the effects of radiation on human tissue. Under such conditions, we may be able to extend this work to provide a mixed radiation field (gamma and neutron) dosimeter which does not require knowing quality factors or energy fluences.

24876 (CONF-9211116–9) **Collection and control of tritium bioassay samples at Pantex.** Fairrow, N.L.; Ivie, W.E. Battelle Pantex, Amarillo, TX (United States). [1992]. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-91AL65030. From 38. annual conference on bioassay, analytical and environmental radiochemistry; Santa Fe, NM (United States); 2-6 Nov 1992. Order Number DE93009922. Source: OSTI; NTIS; INIS; GPO Dep.

Pantex is the final assembly/disassembly point for US nuclear weapons. The Pantex internal dosimetry section monitors radiation workers once a month for tritium exposure. In order to manage collection and control of the bioassay specimens efficiently, a bar code system for collection of samples was developed and implemented to speed up the process and decrease the number of errors probable when transferring data. In the past, all the bioassay data from samples were entered manually into a computer database. Transferring the bioassay data from the liquid scintillation counter to each individual's dosimetry record required as much as two weeks of concentrated effort.

24877 (CONF-9304128–8) **Beta/gamma test problems for ITS.** Mei, G.T. Oak Ridge National Lab., TN (United States). [1993]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From Department of Energy (DOE) radiation protection conference; Las Vegas, NV (United States); 13-15 Apr 1993. Order Number DE93013522. Source: OSTI; NTIS; INIS; GPO Dep.

The Integrated Tiger Series of Coupled Electron/Photon Monte Carlo Transport Codes (ITS 3.0, PC Version) was used at Oak Ridge National Laboratory (ORNL) to compare with and extend the experimental findings of the beta/gamma response of selected health physics instruments. In order to assure that ITS gives correct results, several beta/gamma problems have been tested. ITS was used to simulate these problems numerically, and results for each were compared to the problem's experimental or analytical results. ITS successfully predicted the experimental or analytical results of all tested problems within the statistical uncertainty inherent in the Monte Carlo method.

24878 (DOE/ER/60539–11) **The oncogenic action of ionizing radiation on rat skin: Final progress report, May 1, 1990–April 30, 1992.** Burns, F.J.; Garte, S.J. New York Univ., NY (United States). Dept. of Environmental Medicine. 1992. 62p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-87ER60539. Order Number DE93015580. Source: OSTI; NTIS; GPO Dep.

The multistage theory of carcinogenesis specifies that cells progress to cancer through a series of discrete, irreversible genetic alterations, but data on radiation-induced cancer incidence in rat skin suggests that an intermediate repairable alteration may occur. Data are presented on cancer induction in rat skin exposed to an electron beam (LET=0.34 keV/μ), a neon ion beam (LET=45) or an argon ion beam (LET=125). The rats were observed for tumors at least 78 weeks with squamous and basal cell carcinomas observed. The total cancer yield was fitted by the quadratic equation, and the equation parameters were estimated by linear regression for each type of radiation. Analysis of the DNA from the electron-induced carcinomas indicated that K-ras and/or c-myc oncogenes were activated. In situ hybridization indicated that the cancers contain subpopulations of cells with differing amounts of c-myc and H-ras amplification. The results are consistent with the idea that ionizing radiation produces stable, carcinogenically relevant lesions via 2 repairable events at low LET and via a non-repairable linked event pathway at high LET; either pathway may advance the cell by 1 stage. The proliferative response of rat epidermis following exposure to ionizing radiation was quantified by injection of ^{14}C-thymidine. The return of these cells to S-phase a second time was detected by a second label (^{3}H). When the labeled cells were in G1-phase, the dorsal skin was irradiated with X-rays. All labeling indices were determined. The ^{14}C labeling index was constant and unaffected by the radiation. The proportion of all cells entering S-phase averaged 3.5% at 18 hr and increased after 44, 52 and 75 hr to average levels of 11.8%, 5. 3%, and 6.6% at 0, 10 and 25 Gy respectively. The proportion of S-phase cells labeled with ^{14}C increased after 42 hr and remained relatively constant thereafter.

24879 (DOE/FTR–93011663) **[Travel to Germany and France for standardized nomenclature on the histologic interpretation of lung tumors induced in rats]: Foreign trip report, October 2–14, 1992.** Dagle, G.E. Pacific Northwest Lab., Richland, WA (United States). 11 Nov 1992. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93011663. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The principal purpose of the travel was to participate in a workshop to he l standardize nomenclature on the histologic interpretation of lung tumors induced in rats with radon progeny and other inhaled hazardous materials. This workshop, held in Paris, France, October 12–13, 1992, was organized by the European Late Effects Project Group (EULEP) with participation from the Biological Effects Task Group (BETG) of the US Department of Energy, Office of Health and Environmental Research (OHER). The dates of this workshop were such that they allowed participation of the traveler in the annual meeting of the European Society for Radiation Biology, in Erfurt, Germany, October 4–8, 1992. An ancillary visit was made to the German Cancer Research Center, in Heidelberg, Germany, October 9, 1992, to discuss research with Drs. Horst Wesch and Andres Spiethoff at the Institute for Radiology and Pathophysiology.

24880 (DOE/FTR–93013012) **[Travel to Japan regarding interaction between internally deposited radioactive materials and acute gamma ray exposures in the production of chromosome aberrations]: Foreign trip report, July 11–19, 1992.** Brooks, A.L. Pacific Northwest Lab., Richland, WA (United States). 12 Aug 1992. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93013012. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This trip was taken to provide Dr. Brooks an opportunity to present his research results on the interaction between internally deposited radioactive materials (^{144}Ce and ^{239}Pu) and acute gamma ray exposures in the production of chromosome aberrations. The secondary purpose was to interact with scientists from around the world on the potential biological changes induced in cells and organisms by very low doses of ionizing radiation. This meeting provided a wide range of discussions on low levels of radiation that ranged from the human epidemiology studies to studies on the mechanisms involved in the induction of repair proteins at very low doses of radiation. The meeting was very valuable in helping to shape the future of the research to be conducted in the Cell and mammalian Biology section at the Pacific North West Laboratory.

24881 (DOE-RAS–92.001) **Whole body monitoring of the population of Cambridgeshire: April 1988 - March 1991.** Dendy, P.P. (Addenbrooke's Hospital, Cambridge (United Kingdom)); Hayball, M.P.; Lyttle, K.D. Department of the Environment, London (United Kingdom). Radioactive Substances Div. 1992. [34p.] Contract PECD-7/9/477;WBM/88. Order Number DE93624586. Source: OSTI; NTIS (US Sales Only); INIS.

1220 volunteers were monitored using the Addenbrookes whole-body counter and their spectra and results were stored and analysed. Detailed statistical analyses have been made for 1032 volunteers who were Cambridgeshire residents. After tracking the decline of radiocaesium following Chernobyl, figures were established for the maximum likely average level of body contamination

of radiocaesium and the practical level of detectability of radioiodine. Other radionuclides were occasionally detected in volunteers but the reason could be readily determined and activities were always low. Results are available in a conveniently recoverable form and the spectra can be examined for the presence of other radionuclides if necessary. (author).

24882 (DOE-RAS–92.002) **Measurements of whole-body radioactivity in the UK population.** Fenwick, J.D. (Northern Regional Health Authority (United Kingdom). Regional Medical Physics Dept.); Boddy, K.; McKenzie, A.L.; Oxby, C.B. Department of the Environment, London (United Kingdom). Radioactive Substances Div. 1992. [74p.] Contract PECD-7/9/477. Order Number DE93624587. Source: OSTI; NTIS (US Sales Only); INIS.

A national survey of whole-body radioactivity was undertaken. A mobile whole-body counter visited collaborating Medical Physics Departments and Hospitals in England and Wales. Data were also obtained from an installed whole-body counter at the West Cumberland Hospital, Whitehaven, and from a control site at Addenbrooke's Hospital, Cambridge. 1657 volunteer members of the public were measured, including 162 children. 36% of volunteers had been measured in a similar survey 2 years earlier, and showed between a two and five fold reduction in body radiocaesium. No radiocaesium was detected in 54% of people measured. Measurements showed a progressive fall over the course of the study, reaching a baseline of 0.3 Bq^{137}Cs/gK. In 1989, the additional radiation dose incurred from radiocaesium varied from a maximum of 4.1 μSv in Cumbria to 1.5 μSv in the South East, compared with the average annual radiation dose of 2500 μSv due to all other causes. No other gamma-emitting radionuclides were found. Results are consistent with Chernobyl as the source of the radiocaesium detected. (author).

24883 (DOE/SR/18217–1) **Cancer and birth defects surveillance system for communities around the Savannah River Site: Savannah River Region Health Information System (SRRHIS): Annual progress report.** Dunbar, J.B. Medical Univ. of South Carolina, Charleston, SC (United States). Dept. of Biostatistics, Epidemiology, and System Sciences. May 1992. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG09-91SR18217. Order Number DE93014442. Source: OSTI; NTIS; INIS; GPO Dep.

This report describes efforts directed at establishing a registry of cancers and birth defects that could be associated with activities at the Savannah River Plant.

24884 (INIS-mf–13503, pp. 43-45) **Occupational radiation exposures during maintenance shutdown at Czechoslovak NPPs.** Burclova, J. (Vyskumny Ustav Jadrovych Elektrarni, Trnava (Czechoslovakia)). European Nuclear Society (ENS), Bern (Switzerland); Czech Nuclear Society, Prague (Czech Republic); Slovak Nuclear Society, Bratislava (Slovakia). Jan 1993. (CONF-921068–: East-West topical meeting: the safe and reliable operation of light water reactor NPP's, Prague (Czechoslovakia), 18-21 Oct 1992). In *Topform '92: the safe and reliable operation of LWR NPPs. Vol. II: Poster papers.* [245p.] Order Number DE93625345. Source: OSTI; NTIS (US Sales Only); INIS.

Several graphs are presented giving the dependence of the cumulative occupational radiation exposure on energy production in Czechoslovak and some western PWRs, and the occupational radiation exposure for WWER-440 (type 230) reactors versus duration of the shutdown for reactor maintenance. (Z.S.) 5 figs.

24885 (INIS-mf–13518, pp. Z9) **Natural radionuclide content of some components of the environment as affected by the geologic structure of the Pribram geologic region.** Solnicka, H. (Ustav Hygieny Prace v Uranovem Prumyslu, Kamenna (Czechoslovakia)); Kubicek, I.; Merta, J. 1992. [76p.] (In Czech). (CONF-9210351–: The mining town of Pribram in science and technology, Pribram (Czechoslovakia), 12-14 Oct 1992). In *The mining town of Pribram in science and technology. Abstracts of contributions.* Order Number DE93625342. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. RADON 222/radiation monitoring; INHALATION; NATURAL RADIOACTIVITY; RADIATION HAZARDS; REGULATIONS

24886 (INIS-mf–13518, pp. Z10) **Estimate of radiation burden of the population of the North Bohemian mining region due to activities of the Czechoslovak Uranium Industry corporation.** Nemec, M. (Ustav Hygieny Prace v Uranovem Prumyslu, Kamenna (Czechoslovakia)). 1992. [76p.] (In Czech). (CONF-9210351–: The mining town of Pribram in science and technology, Pribram (Czechoslovakia), 12-14 Oct 1992). In *The mining town of Pribram in science and technology. Abstracts of contributions.* Order Number DE93625342. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. RADIATION DOSES/human populations; ENVIRONMENTAL IMPACTS; RADIATION HAZARDS; URANIUM MINES

24887 (INIS-mf–13518, pp. Z12) **Effects of uranium industry tailings on the population.** Hladka, E. (Ustav Hygieny Prace v Uranovem Prumyslu, Kamenna (Czechoslovakia)); Hemer, M. 1992. [76p.] (In Czech). (CONF-9210351–: The mining town of Pribram in science and technology, Pribram (Czechoslovakia), 12-14 Oct 1992). In *The mining town of Pribram in science and technology. Abstracts of contributions.* Order Number DE93625342. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. TAILINGS/radiation monitoring; CONTAMINATION; ENVIRONMENTAL IMPACTS; NATURAL RADIOACTIVITY; RADIATION HAZARDS; TAILINGS

24888 (INIS-mf–13518, pp. Z13) **Radiation protection in the surroundings of the MAPE Mydlovary chemical treatment plant.** Placek, V. (Ustav Hygieny Prace v Uranovem Prumyslu, Kamenna (Czechoslovakia)); Matzner, J. 1992. [76p.] (In Czech). (CONF-9210351–: The mining town of Pribram in science and technology, Pribram (Czechoslovakia), 12-14 Oct 1992). In *The mining town of Pribram in science and technology. Abstracts of contributions.* Order Number DE93625342. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. TAILINGS/radiation protection; CONTAMINATION; FLY ASH; GROUND WATER; HUMAN POPULATIONS; RADIATION HAZARDS; RADIATION MONITORING; RADON 222; SOILS; TAILINGS

24889 (INIS-mf–13518, pp. Z11) **Ionizing radiation burden of the population of the Dolni Rozinka mining region.** Placek, V. (Ustav Hygieny Prace v Uranovem Prumyslu, Kamenna (Czechoslovakia)); Hladka, E.; Hemer, M.; Ditrich, J. 1992. [76p.] (In Czech). (CONF-9210351–: The mining town of Pribram in science and technology, Pribram (Czechoslovakia), 12-14 Oct 1992). In *The mining town of Pribram in science and technology. Abstracts of contributions.* Order Number DE93625342. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. URANIUM MINES/radiation hazards; HUMAN POPULATIONS/radiation doses; DRINKING WATER; ENVIRONMENTAL IMPACTS; NATURAL RADIOACTIVITY; RADIATION MONITORING; CZECHOSLOVAKIA

24890 (INIS-mf–14145) **Radiological protection. Radioactivity and health.** Borsch, P. (Forschungszentrum Juelich GmbH (Germany). Programmgruppe Mensch, Umwelt, Technik (MUT)); Feinendegen, L.; Muench, E.; Paschke, M.; Feldmann, A. Bayerisches Staatsministerium fuer Landesentwicklung und Umweltfragen, Muenchen (Germany). Dec 1991. 229p. (In German). Order Number DE93792710. Source: OSTI; NTIS (US Sales Only); INIS.

The brochure tries to make understandable also for nonprofessionals the conncetion between radioactivity and health. After briefly discussing the foundations of radioactivity, radiation emanating from radioactive materials, and the terms of dose, it deals with natural and man-made exposure of man in the age of industry. Its effects on man are thoroughly considered with regard to possible health injuries and genotype changes. The explanation of radioecological correlations, from radioactive effluents from nuclear installations to the determination of radiation exposure of man, takes into account effluents during normal operation and effluents caused by accidents, giving as an example the Chernobyl reactor accident. It is supplemented by describing the risks involved in the application of ionizing radiation in medicine. Subsequent chapters

reflect the results obtained in many years of research into questions of radiation hazards, and they are to contribute to a matter-of-fact information about this important area. A comprehensive bibliography facilitates access to specialized literature. (orig.).

24891 (INIS-mf–14147) **Volume of baseline data on radioactivity in drinking water, ground water, waste water, sewage sludge, residues and wastes of the annual report 1988 'Environmental radioactivity and radiation exposure'.** WaBoLu-Hefte. Abelmann, S.; Buenger, T.; Fusban, H.U.; Ruehle, H.; Viertel, H.; Gans, I. Bundesgesundheitsamt, Berlin (Germany). Inst. fuer Wasser-, Boden- und Lufthygiene. 1991. 209p. (In German). Order Number DE93795221. Source: OSTI; NTIS (US Sales Only); INIS.

This WaBoLu volume is a shortened version of the annual report by the Federal Ministry of the Environment, Nature Protection and Reactor Safety 'Environmental radioactivity and radiation exposure' and gives an overview of the data on radioactivity in drinking water, ground water, waste water, sewage sludge, residues and wastes, compiled for the area of the Federal Republic of Germany in 1988 by the Institute of Water, Soil and Air Hygiene (WaBoLu) of the Federal Health Office. (BBR) With 22 figs., 15 tabs.

24892 (JAERI-M–93-025) **System for keeping atmospheric pressure in nuclear facility and its peripheral equipments.** Matsumoto, Hatsuo (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Tokai Research Establishment). Japan Atomic Energy Research Inst., Tokyo (Japan). Feb 1993. 76p. (In Japanese). Order Number DE93797611. Source: OSTI; NTIS; INIS.

The design to keep radioactive materials in the facility and not to make them spread inside the facility and into the environments is an essential issue in the construction of nuclear facilities. One reason of the contamination is due to the diffusion with air flow, therefore, negative pressure for the ambients has been utilized to keep gaseous radioactivities inside the facility of interest. The pressure difference is not so large, though, the atmospheric pressure level of the contaminated and possibly contaminated areas are always kept to be lower than those of the ambient one to prevent the dissemination of radioactivity from the defined area. The technique using negative pressure, at present, is employed widely in nuclear facilities, and the basic system is the same as that of JRR-1 built as the first nuclear facility in Japan. In the present work, the conventional system with negative pressure was reexamined on the sate-of-art of the regulations for the nuclear facilities, and consequently some shortages of the system has been found. Thus, an advanced system with an excellent performance keeping the negative pressure has been developed to cover the shortage. In this report, the new system is introduced with a couple of comments, acquired from the author's experience, to the design and the maintenance of the composite equipments of the system. (author).

24893 (KURRI-TR–373) **The records of radiation control division, No. 27: April, 1990 - March, 1992.** Saito, Masahiro (ed.) (and others); Ikushima, Takaji; Fukui, Masami. Kyoto Univ., Kumatori, Osaka (Japan). Research Reactor Inst. Mar 1993. 91p. (In Japanese). Order Number DE93797621. Source: OSTI; NTIS; INIS.

The Radiation Control Division consists of three sections : Indoor Radiation Control, Field Radiation Monitoring, and Individual Monitoring sections. Nineteen members, including research scientists and technicians, are now organized for the safety-oriented operation of the nuclear reactor, the safety-management of the laboratory works in the hot area. The present report summarizes the safety management carried out by these three sections during April 1990 - March 1992. Additionally, the tasks managed by the staff of Office of Health Physics are described. (author).

24894 (LA-SUB–93-74) **MACCS versus GENII: Code comparison.** Foster, J. (Technadyne Engineering Consultants, Inc., Albuquerque, NM (United States)); Chanin, D.I. Los Alamos National Lab., NM (United States); Technadyne Engineering Consultants, Inc., Albuquerque, NM (United States). 30 Sep 1991. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. Order Number DE93008468. Source: OSTI; INIS; NTIS (documentation only); ESTSC (complete software package), P.O. Box 1020, Oak Ridge, TN 37831-1020; GPO Dep.

The computer codes GENII and MACCS, utilized for computing radiation doses, are discussed. The codes are compared from input from the source term from LANL file HW101-SY.INP, run dated 2/19/91. The release of radionuclides was assumed to be from a point source at ground level with a 10 minute release duration.Doses were calculated at a distance of 660 meters with an exposure duration of 2 hours. It was found that the 2 codes differed in how wind direction was treated.

24895 (LA-UR–93-747) **Report on high energy neutron dosimetry workshop.** Alvar, K.R.; Gavron, A. Los Alamos National Lab., NM (United States). 27 Jan 1993. 99p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9211228–1: High energy neutron dosimetry workshop, Gaithersburg, MD (United States), 19 Nov 1992). Order Number DE93010729. Source: OSTI; NTIS; INIS; GPO Dep.

The workshop was called to assess the performance of neutron dosimetry per the responses from ten DOE accelerator facilities to an Office of Energy Research questionnaire regarding implementation of a personnel dosimetry requirement in DRAFT DOE 5480.ACC, "Safety of Accelerator Facilities". The goals of the workshop were to assess the state of dosimetry at high energy accelerators and if such dosimetry requires improvement, to reach consensus on how to proceed with such improvements. There were 22 attendees, from DOE Programs and contract facilities, DOE, Office of Energy Research (ER), Office of Environmental Safety and Health (EH), Office of Fusion Energy, and the DOE high energy accelerator facilities. A list of attendees and the meeting agenda are attached. Copies of the presentations are also attached.

24896 (LMF–138) **Inhalation Toxicology Research Institute annual report, October 1, 1991–September 30, 1992.** Finch, G.L.; Nikula, K.J.; Bradley, P.L. (eds.). Lovelace Biomedical and Environmental Research Inst., Albuquerque, NM (United States). Inhalation Toxicology Research Inst. Dec 1992. 288p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76EV01013. Order Number DE93013024. Source: OSTI; NTIS; INIS; GPO Dep.

The mission of ITRI is to conduct basic and applied research to improve our understanding of the nature and magnitude of the human health impacts of inhaling airborne materials in the home, workplace, and general environment. Institute research programs have a strong basic science orientation with emphasis on the nature and behavior of airborne materials, the fundamental biology of the respiratory tract, the fate of inhaled materials and the mechanisms by which they cause disease, and the means by which data produced in the laboratory can be used to estimate risks to human health. The papers in this annual report are organized along topical lines, rather than by research program, so that research within specific disciplines is more readily identified. The papers include summaries of research funded by both DOE and non-DOE sources, to represent the full scope of Institute activities. One section consists of summaries of research on the effects of injected actinides, conducted for DOE at the University of Utah.

24897 (NEI-NO–330) **Studies on levels and interactions of contact activation factors in plasma: A basis for the elucidation of their function in anaphylactoid reactions to dextran and to radiographic contrast media.** Hoem, N.O. Oslo Univ. (Norway). 1992. [102p.] Order Number DE93625751. Source: OSTI; NTIS; INIS.

Reprints of eight previously printed papers are attached.

Summary of findings and conclusions of relevance: A part of the thesis concerns the effects of intravenous contrast media on the blood pressure and on factors of the contact activation system in the rat. The intravenous injection of dextran induced a profound and lasting fall in blood pressure, preceded by significant lowering in prekallikrein and activation factor 12. The non-ionic radiographic contrast media iohexol caused no significant alterations, neither in blood pressure, nor in levels of contact factors, whereas the ionic radiographic contrast media iodipamide had effects. It induced a rapid, but short-lived, fall in blood pressure and a small, but statistically significant reduction in the measurable amount of activation factor 12a. An observation of significance was that pretreatment of the rats with iodipamide almost blocked the dextran-induced blood pressure fall, and abolished the reduction in prekallikrein and activation factor 12a. It is concluded that the ionic radiographic

contrast media used was capable of blocking dextran shock in the rat by preventing an activation of contact activation system. 130 refs., 5 figs.

24898 (ORNL/FTR–4257) **Travel to Sweden to participate in the Seminar on the Dynamic Behavior of Radionuclides in Forests: Foreign trip report, May 16–23, 1992.** Garten, C.T. Jr. Oak Ridge National Lab., TN (United States). 3 Jun 1992. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93011080. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The Swedish Radiation Protection Institute (SSI) hosted a one-week conference, Seminar on the Dynamic Behavior of Radionuclides in Forests, at the Norra Latin Conference Center in Stockholm from May 18 to May 22, 1992. The traveler presented an introductory paper on behalf of F. Owen Hoffman, Oak Ridge National Laboratory, in the session on Deposition and Interception of Radionuclides by Forests and chaired the session Contamination of Wildlife in which the traveler presented a paper on dispersal of radioactivity by wildlife. There was considerable international interest in the topic of this conference; 86 participants representing more than 20 countries were there, and there were more than 75 plenary, oral, or poster presentations. Scientists from the former Union of Soviet Socialist Republics (USS.R) made significant and interesting presentations based on studies of radioactive forests at Kyshtym and Chernobyl. The format of the meeting included both formal presentations and a one-day workshop that addressed environmental issues centered on four broad themes relating to forest habitats and radioactive contamination. CEC will arrange for papers at the seminar to be published in a special volume of the journal Science of the environment.

24899 (ORNL/TM–11916) **Improving neutron dosimetry using bubble detector technology.** Buckner, M.A. Oak Ridge National Lab., TN (United States). Feb 1993. 96p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93013453. Source: OSTI; NTIS; INIS; GPO Dep.

Providing accurate neutron dosimetry for a variety of neutron energy spectra is a formidable task for any dosimetry system. Unless something is known about the neutron spectrum prior to processing the dosimeter, the calculated dose may vary greatly from that actually encountered; that is until now. The entrance of bubble detector technology into the field of neutron dosimetry has eliminated the necessity of having an a priori knowledge of the neutron energy spectra. Recently, a new approach in measuring personnel neutron dose equivalent was developed at Oak Ridge National Laboratory. By using bubble detectors in combination with current thermoluminescent dosimeters (TLDs) as a Combination Personnel Neutron Dosimeter (CPND), not only is it possible to provide accurate dose equivalent results, but a simple four-interval neutron energy spectrum is obtained as well. The components of the CPND are a Harshaw albedo TLD and two bubble detectors with theoretical energy thresholds of 100 key and 1500 keV. Presented are (1) a synoptic history surrounding emergence of bubble detector technology, (2) a brief overview of the current theory on mechanisms of interaction, (3) the data and analysis process involved in refining the response functions, (4) performance evaluation of the original CPND and a reevaluation of the same data under the modified method, (5) the procedure used to determine the reference values of component fluence and dose equivalent for field assessment, (6) analysis of the after-modification results, (7) a critique of some currently held assumptions, offering some alternative explanations, and (8) thoughts concerning potential applications and directions for future research.

24900 (ORNL/TM–12148) **Resolution of dose and reduction factor questions in Army Pulse Radiation Facility experiments: Renormalization of calculated and measured data.** Santoro, R.T.; Drischler, J.D.; Johnson, J.O. Oak Ridge National Lab., TN (United States). Nov 1992. 27p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93012507. Source: OSTI; NTIS (US Sales Only); GPO Dep.

A procedure is introduced to normalize calculated and measured dose and reduction factors for a series of experiments performed at the Army Pulse Radiation Facility. In an attempt to isolate causes of the differences among these data, the data are reevaluated on the basis that the free-field neutron and gamma-ray fluence at 400 m from the reactor should be constant within air and ground moisture conditions. When the dose data are compared relative to the number of free-field neutrons, significant improvements are realized in the calculated-to measured data ratios. Discrepancies in previously reported results appear to be traceable to differences in the number of free-field neutrons and the γ/n ratio at the measurement location.

24901 (PNL–3777-Rev.2) **Recommended environmental dose calculation methods and Hanford-specific parameters: Revision 2.** Schreckhise, R.G. (Pacific Northwest Lab., Richland, WA (United States)); Rhoads, K.; Napier, B.A.; Ramsdell, J.V.; Davis, J.S. Pacific Northwest Lab., Richland, WA (United States). Mar 1993. 272p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93012832. Source: OSTI; NTIS; INIS; GPO Dep.

This document was developed to support the Hanford Environmental Dose overview Panel (HEDOP). The Panel is responsible for reviewing all assessments of potential doses received by humans and other biota resulting from the actual or possible environmental releases of radioactive and other hazardous materials from facilities and/or operations belonging to the US Department of Energy on the Hanford Site in south-central Washington. This document serves as a guide to be used for developing estimates of potential radiation doses, or other measures of risk or health impacts, to people and other biota in the environs on and around the Hanford Site. It provides information to develop technically sound estimates of exposure (i.e., potential or actual) to humans or other biotic receptors that could result from the environmental transport of potentially harmful materials that have been, or could be, released from Hanford operations or facilities. Parameter values and information that are specific to the Hanford environs as well as other supporting material are included in this document.

24902 (PNL-SA–21011) **Bioassay criteria for environmental restoration workers.** Carbaugh, E.H.; Bihl, D.E. Pacific Northwest Lab., Richland, WA (United States). Jan 1993. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-930130–9: 26. Health Physics Society midyear topical meeting on environmental health physics, Coeur d'Alene, ID (United States), 24-28 Jan 1993). Order Number DE93007997. Source: OSTI; NTIS; INIS; GPO Dep.

Environmental restoration (ER) work at the U. S. Department of Energy Hanford Site posed questions concerning when to perform bioassay monitoring of workers for potential intakes of radioactivity. Application of criteria originally developed for use inside radionuclide processing facilities to ER work resulted in overly restrictive bioassay requirements. ER work typically involves site characterization or, excavating large quantities of potentially contaminated soil, rather than working with concentrated quantities of radioactivity as in a processing facility. An improved approach, tailored to ER work, provided soil contamination concentrations above which worker bioassay would be required. Soil concentrations were derived assuming acute or chronic intakes of 2% of an Annual Limit on Intake (ALI), or a potential committed effective dose equivalent of 100 mrem, and conservative dust loading of air from the work. When planning ER work, the anticipated soil concentration and corresponding need for bioassay could be estimated from work-site historical records. Once site work commenced, soil sampling and work-place surveys could be used to determine bioassay needs. This approach substantially reduced the required number of bioassay samples with corresponding reductions in analytical costs, schedules, and more flexible work-force management. (Work supported by the US Department of Energy under contract DOE-AC06-76RLO 1830.)

24903 (PNL-SA–21014) **Identification of environmentally derived cesium-137 burdens in a worker population.** MacLellan, J.A.; Lynch, T.P.; Rieksts, G.A.; Brodzinski, R.L. Pacific Northwest Lab., Richland, WA (United States). Jan 1993. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-930130–10: 26. Health Physics Society midyear topical meeting on environmental health physics, Coeur

d'Alene, ID (United States), 24-28 Jan 1993). Order Number DE93007996. Source: OSTI; NTIS; INIS; GPO Dep.

During 1990, whole body measurements of a number of workers with little probability of onsite occupational exposure showed positive evidence of ^{137}Cs. Further investigation revealed that many of these workers supplemented their diet with a significant portion of wild game, mainly deer and elk. To validate the assumption of an environmental source, donated samples of venison and other game were analyzed by gamma spectroscopy. Results ranged from less than 0.1 to almost 100 Bq kg^{-1} (0.003 to 2.7 nCi kg^{-1}) and showed a correlation with the habitat from which the game was taken. Venison samples obtained from the two workers with the highest body burdens showed the highest activity. A questionnaire is now used to identify workers with an elevated potential for environmental-intakes.

24904 (PNL-SA–21972) **Development and maintenance of the Hanford Site Radiological Control Manual.** Munson, L.H.; Selby, J.M; Vargo, G.J.; Clark, D.L. Pacific Northwest Lab., Richland, WA (United States). Apr 1993. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-9304128–7: Department of Energy (DOE) radiation protection conference, Las Vegas, NV (United States), 13-15 Apr 1993). Order Number DE93013158. Source: OSTI; NTIS; INIS; GPO Dep.

In June 1992 the US Department of Energy (DOE) issued DOE N5480.6, Radiological Control, which set forth DOE's Radiological Control Program and established the framework for its implementation at sites nationwide. Accompanying the Order was the DOE Radiological Control Manual (DOE RCM), which provided the detailed requirements for the program. The Order also mandated Field Office issuance of site-specific radiological control manuals by December 1, 1992. This paper presents the approach taken to develop, review, approve, implement, and subsequently maintain the site-specific manual for the DOE Richland Field Office (RL) at Hanford Site.

24905 (PNL-SA–22241) **Personnel dose assignment practices.** Fix, J.J. Pacific Northwest Lab., Richland, WA (United States). Apr 1993. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-9304128–1: Department of Energy (DOE) radiation protection conference, Las Vegas, NV (United States), 13-15 Apr 1993). Order Number DE93013285. Source: OSTI; NTIS; INIS; GPO Dep.

Implementation of DOE N 5480.6 Radiological Control Manual Article 511(3) requirements, to minimize the assignment of personnel dosimeters, should be done only under a broader context ensuring that capabilities are in place to monitor and record personnel exposure both for compliance and for potential litigation. As noted in NCRP Report No. 114, personnel dosimetry programs are conducted to meet four major objectives: radiation safety program control and evaluation; regulatory compliance; epidemiological research; and litigation. A change to Article 511(3) is proposed that would require that minimizing the assignment of personnel dosimeters take place only following full evaluation of overall capabilities (e.g., access control, area dosimetry, etc.) to meet the NCRP objectives.

24906 (PNWD–1980-10-HEDR) **Hanford Environmental Dose Reconstruction Project monthly report, March 1993.** Cannon, S.D.; Finch, S.M. (comps.). Battelle Pacific Northwest Lab., Richland, WA (United States). Mar 1993. 57p. Sponsored by Department of Health and Human Services, Washington, DC (United States). Order Number DE93012321. Source: OSTI; NTIS; INIS.

The objective of the Hanford Environmental Dose Reconstruction (HEDR) Project is to estimate the radiation doses that individuals and populations could have received from nuclear operations at Hanford since 1944. The project is divided into the following technical tasks. These tasks correspond to the path radionuclides followed from release to impact on humans (dose estimates): Source Terms, Environmental Transport, Environmental Monitoring Data, Demography, Food Consumption, and Agriculture and Environmental Pathways and Dose Estimates.

24907 (PNWD–2020-HEDR) **Integrated task plans for the Hanford Environmental Dose Reconstruction Project, FY 1992 through May 1994.** Shipler, D.B. Pacific Northwest Lab., Richland, WA (United States). Mar 1993. 247p. Sponsored by Department of Health and Human Services, Washington, DC (United States). Order Number DE93011651. Source: OSTI; NTIS; INIS.

The purpose of the Hanford Environmental Dose Reconstruction (HEDR) Project is to estimate radiation doses from Hanford Site operations since 1944 to real and representative individuals. The primary objective of work to be performed through May 1994 is to (1) determine the project's appropriate scope (space, time, radionuclides, pathways, and representative individuals), (2) determine the project's appropriate level of accuracy (level of uncertainty in dose estimates), (3) complete model and data development, and (4) estimate doses for the Hanford Thyroid Disease Study (HTDS), representative individuals, and other real individuals as described herein. This document was prepared to address modifications and work revisions.

24908 (PNWD–2033-HEDR-Vol.1) **Iodine-131 releases from the Hanford Site, 1944–1947: Volume 1, Text: Hanford Environmental Dose Reconstruction Project.** Heeb, C.M. Pacific Northwest Lab., Richland, WA (United States). Mar 1993. 133p. Sponsored by Department of Health and Human Services, Washington, DC (United States). DOE Contract AC06-76RL01830. Contract 200-92-0503(CDC)/18620(BNW). Order Number DE93011909. Source: OSTI; NTIS; INIS; GPO Dep.

Releases of fission product iodine-131 are calculated for the 1944 through 1947 period from the Hanford Reservation. Releases to the atmosphere were from the ventilation stacks of T and B separation plants. A reconstruction of daily separation plant operations forms the basis of the releases. The reconstruction traces the iodine-131 content of each fuel discharge from the B, D, and F Reactors to the dissolving step in the separation plants. Statistical computer modeling techniques are used to estimate hourly release histories based on sampling mathematical distribution functions that express the uncertainties in the source data and timing. The reported daily, monthly, and yearly estimates are averages and uncertainty ranges are based on 100 independent Monte Carlo "realizations" of the hourly release histories.

24909 (PNWD–2113-HEDR-Draft) **Estimation of 1945 to 1957 food consumption: Hanford Environmental Dose Reconstruction Project: Draft.** Anderson, D.M.; Bates, D.J.; Marsh, T.L. Pacific Northwest Lab., Richland, WA (United States). Mar 1993. 171p. Sponsored by Department of Health and Human Services, Washington, DC (United States). DOE Contract AC06-76RL01830. Contract 200-92-0503(CDC);Contract 18620(BNW). Order Number DE93011017. Source: OSTI; NTIS; GPO Dep.

This report details the methods used and the results of the study on the estimated historic levels of food consumption by individuals in the Hanford Environmental Dose Reconstruction (HEDR) study area from 1945–1957. This period includes the time of highest releases from Hanford and is the period for which data are being collected in the Hanford Thyroid Disease Study. These estimates provide the food-consumption inputs for the HEDR database of individual diets. This database will be an input file in the Hanford Environmental Dose Reconstruction Integrated Code (HEDRIC) computer model that will be used to calculate the radiation dose. The report focuses on fresh milk, eggs, lettuce, and spinach. These foods were chosen because they have been found to be significant contributors to radiation dose based on the Technical Steering Panel dose decision level.

24910 (PNWD–2129-HEDR) **List of currently classified documents relative to Hanford Production Facilities Operations originated on the Hanford Site between 1961 and 1972.** Battelle Pacific Northwest Lab., Richland, WA (United States). Apr 1993. 255p. Sponsored by Department of Health and Human Services, Washington, DC (United States). DOE Contract AC06-76RL01830. Contract 200-92-0503(CDC)/18620(BNW). Order Number DE93012621. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The United States Department of Energy (DOE) has declared that all Hanford plutonium production- and operations-related information generated between 1944 and 1972 is declassified. Any documents found and deemed useful for meeting Hanford Environmental Dose Reconstruction (HEDR) objectives may be declassified with or without deletions in accordance with DOE guidance by Authorized Derivative Declassifiers. The September 1992,

letter report, Declassifications Requested by the Technical Steering Panel of Hanford Documents Produced 1944–1960, (PNWD-2024 HEDR UC-707), provides an important milestone toward achieving a complete listing of documents that may be useful to the HEDR Project. The attached listing of approximately 7,000 currently classified Hanford-originated documents relative to Hanford Production Facilities Operations between 1961 and 1972 fulfills TSP Directive 89-3. This list does not include such titles as the Irradiation Processing Department, Chemical Processing Department, and Hanford Laboratory Operations monthly reports generated after 1960 which have been previously declassified with minor deletions and made publicly available. Also Kaiser Engineers Hanford (KEH) Document Control determined that no KEH documents generated between January 1, 1961 and December 31, 1972 are currently classified. Titles which address work for others have not been included because Hanford Site contractors currently having custodial responsibility for these documents do not have the authority to determine whether other than their own staff have on file an appropriate need-to-know. Furthermore, these documents do not normally contain information relative to Hanford Site operations.

24911 (SR/H–522) **[Function and organization of the Medical Department of the Hanford Engineer Works].** Norwood, W.D.; Meekins, R.L.; Cantril, S.T.; Fuqua, P.A. Hanford Engineer Works, Richland, WA (United States). [1946]. 133p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. Order Number DE93012362. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The Medical Department of the Hanford Engineer Works is responsible for providing medical and dental service to the plant employees and the Village residents. This function entails the operation of Kadlec Hospital and the Medical-Dental Clinic, as well as all activities of the Public Health Section, the Plant Medical Section, and the Health Instrument Section. The latter two Sections together comprise the Industrial Medical Division of the department. This memorandum reviews the functions and organization of the Medical Department from its inception to August 1946. Included also is a summary of experience with the procurement and training of personnel.

24912 (UCRL-ID–111417) **Proposed performance degradation algorithms for multiburst environments.** Olness, D.U.; Warshawsky, A.S. Lawrence Livermore National Lab., CA (United States). 23 Jun 1992. 12p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract W-7405-ENG-48. Contract IACRO 91-808. Order Number DE93013308. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This work is a part of an ongoing effort of the Defense Nuclear Agency's Intermediate Dose Program (IDP) to investigate the effects of intermediate radiation doses on combat unit performance. The objective of this study is to develop a technique for applying performance degradation factors to combat crews in simulated battles following a second or third nuclear attack. In this paper, the authors describe three methods they have identified.

24913 (UCRL-JC–109590) **The role of x-ray induced damage in biological micro-imaging.** London, R.A. (Lawrence Livermore National Lab., CA (United States)); Trebes, J.E.; Jacobsen, C.J. Lawrence Livermore National Lab., CA (United States). Oct 1992. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-920792–55: Society of Photo-Optical Instrumentation Engineers (SPIE) international symposium on optical applied science and engineering, San Diego, CA (United States), 19-24 Jul 1992). Order Number DE93013353. Source: OSTI; NTIS; GPO Dep.

Interactions of x rays with a sample are studied to determine the optimal wavelength, source energy and exposure time for microscopy and holography. The optimal wavelength is influenced by two criteria: minimizing the required source energy and minimizing the absorbed dose and subsequent damage to the sample. The use of heavy element labels, such as colloidal gold can significantly reduce the energy and dose. Limits to the exposure time due to natural motions, x-ray induced chemical damage, heat build-up, and hydrodynamic expansion are discussed.

24914 (WSRC-MS–93-067) **Radiological comparison guideline and nuclear safety goals.** Kim, K.S.; Bradley, R.F. Westinghouse Savannah River Co., Aiken, SC (United States). [1993]. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. (CONF-9306143–3: Energy Facility Contractors Group safety analysis meeting, Denver, CO (United States), 16-18 Jun 1993). Order Number DE93012133. Source: OSTI; NTIS; INIS; GPO Dep.

The Westinghouse Managing and Operating (M&O) Contractors Nuclear Facility Safety Committee proposed a guideline for radiological risk comparison . The M&O guideline, (as a form of Limit Line) is intended to be used for evaluating the acceptability of consequences and associated frequency/probability of individual accident events. That is, the guideline is a Farmer's Limit Line rather than a Limit Line based on the complementary cumulative distribution function (CCDF).

24915 (Y/DQ–39) **A model for uranium lung clearance at the Y-12 Plant.** Barber, J.M.; Forrest, R. Oak Ridge Y-12 Plant, TN (United States). 2 Mar 1992. 35p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OS21400. Order Number DE93013255. Source: OSTI; NTIS; INIS; GPO Dep.

Previous examinations of Y-12 bioassay data have shown. with the exception of five anomalous cases, the typical hall clearance time for uranium in the lung to be approximately 120 days. These findings are consistent with those of a fuel fabrication facility in Germany. The Y-12 study investigated human exposure to the least transportable uranium materials commonly found (U_3O_8 and UO_2) at the Y-12 Plant. Use of a deposition and retention model based on exposure to these forms would be conservative for other chemical forms of uranium normally processed at the plant. Particle-size and lung-clearance studies were made in order to collect of observed bioassay data. Particle-size data for a model more representative determinations were made by using electron microscopy on independent air samples taken during periods of production as well as during periods of nonproduction. The lung-clearance study was a two-part investigation. The first part consisted of a further analysis of historical personnel exposure cases involving uranium oxides. These cases included individuals who were restricted from uranium work for six months or longer because their bioassay results exceeded the criteria for restriction. The second part consisted of a contemporary study which examined uranium clearance from several individuals removed from low-level chronic uranium exposure specifically for this study. The individuals involved in the contemporary study were chosen because their work areas and historical bioassay data indicated low-level chronic exposure to uranium oxides for 10 or longer.

24916 (Y/DQ–40) **Technical basis for the internal dosimetry program at the Y-12 Plant.** Ashley, J.C.; Barber, J.M.; Snapp, L.M.; Turner, J.E. Oak Ridge Y-12 Plant, TN (United States). 2 Mar 1992. 52p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OS21400. Order Number DE93013256. Source: OSTI; NTIS; INIS; GPO Dep.

Since the beginning of plant operations. almost all work with radioactive materials has involved isotopes associated with uranium, enriched or depleted in U^{235}. While limited quantities of isotopes of elements other than uranium are present, workplace monitoring and precess knowledge have established that internal exposure from these other isotopes is insignificant in comparison with uranium. While the changing plant mission may necessitate the consideration of internal exposure from other isotopes at some point in time, only enriched and depleted uranium will be considered in this basis document. The portions of the internal dosimetry technical basis which may be unique to the Y-12 Plant is considered in this manual. This manual presents the technical basis of the routine in vivo and in vitro bioassay programs including choice of frequency, participant selection criteria, and action level guidelines. Protocols for special bioassay will be presented in the chapters which described the basis for intake, uptake, and dam assessment. A discussion of the factors which led to the need to develop a special biokinetic model for uranium at the Y-12 Plant, as well as a description of the model's basic parameters, are included in this document.

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Refer also to citation(s) 23092, 24567, 24640, 24665, 24670, 24679, 24685, 24689, 24691, 24693, 24699, 24746, 24747, 24770, 24813, 24826, 24896

24917 (ANL–93/7) **Lead exposures and biological responses in military weapons systems: Aerosol characteristics and acute lead effects among US Army artillerymen: Final report.** Bhattacharyya, M.H.; Stebbings, J.H.; Peterson, D.P.; Johnson, S.A.; Kumar, R.; Goun, B.D.; Janssen, I.; Trier, J.E. Argonne National Lab., IL (United States). Mar 1993. 138p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract W-31109-ENG-38. Order Number DE93012075. Source: OSTI; NTIS; GPO Dep.

This study was to determine the concentration and chemical nature of lead (Pb) aerosols produced during the firing of artillery and to determine the exposures and biological responses of crew members exposed to lead aerosols during such firing. The concentrations of lead-containing aerosols at crew positions depended on wind conditions, with higher concentrations when firing into a head wind. Aerosol concentrations were highest in the muzzle blast zone. Concentrations of lead in the blood of crew members rose during the first 12 days of exposure to elevated airborne lead concentrations and then leveled off. There was no rapid decrease in blood lead concentrations after completion of firing. Small decreases in hematocrit and small increases in free erythrocyte porphyrin were correlated with increasing exposure to airborne lead. These changes were reversed by seven weeks after firing. Changes in nerve conduction velocity had borderline statistical significance to airborne lead exposure. In measuring nerve conduction velocity, differences in skin temperature must be taken into account.

24918 (CFS/OO–46-13/35-1991E, pp. 97-111) **Effects of acid rain on forest vegetation: Morphological and nonmensurational growth effects.** Percy, K.E. (Canadian Forestry Service, Fredericton, NB (Canada)). Canadian Forestry Service, Ottawa, ON (Canada). 1991. (CONF-8306311–: Effects of acid rain on forest resources, Sainte-Foy (Canada), 14-17 Jun 1983; MICROLOG–92-03656). In *Effects of acid rain on forest resources: Proceedings.* 667p. Source: PC Forestry Canada, Place Vincent Massey, 351 St. Joseph Blvd., Ottawa, ON, CAN K1A 1G5; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1 PC PRICES UPON REQUEST; MF $10 CAN.

Acid rain is widely perceived to be a threat to forest resources in eastern Canada. The majority of rainfall events in this area have a pH of 4.0-4.5 with most of the more acidic events occurring during the active growing season. Although field injury has yet to be documented, experimental evidence with seedling-stage plants suggests that direct damage to forest tree species can be induced under controlled conditions using simulated rainfall techniques. Seed germination can be inhibited, but usually only at extreme rainfall acidities. Inhibition is generally more severe in deciduous species than in coniferous. In contrast, seedling growth and development can be affected by near-ambient rainfall pH. Observed morphological effects include reductions in the rates of needle and secondary meristem initiation, and in shoot apex size. Growth effects include decreased height and reductions in hypocytyl, cotyledon and needle elongation. Leaf wettability and rainwater penetration rate through the cuticle may be altered as a result of chemical or physical modifications to leaf surface structure by acidic solutions. Macroscopic lead injury has not been detected at simulated pH above 3.4. Little is yet known about cellular or sub-cellular effects. Preliminary species-sensitivity data are available, but interspecific variation in seedling response is large, and further work is required before extrapolation to the field situation can be made. 56 refs., 4 tabs.

24919 (CFS/OO–46-13/35-1991E, pp. 121-130) **Photosynthesis of woody plants: The impact of acidic pollutants, oxidants, and heavy metals.** Jensen, K.F. (United States Dept. of Agriculture, Forest Service, Delaware, OH (United States)). Canadian Forestry Service, Ottawa, ON (Canada). 1991. (CONF-8306311–: Effects of acid rain on forest resources, Sainte-Foy (Canada), 14-17 Jun 1983; MICROLOG–92-03656). In *Effects of acid rain on forest resources: Proceedings.* 667p. Source: PC Forestry Canada, Place Vincent Massey, 351 St. Joseph Blvd., Ottawa, ON, CAN K1A 1G5; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1 PC PRICES UPON REQUEST; MF $10 CAN.

Air pollutants reduce the photosynthetic rate of both deciduous and conifer trees. The reduction varies with the pollutant, the dose, and the plant species. Sulfur dioxide and ozone can cause significant reduction in photosynthesis before visible injury can be observed. The reductions are usually only measurable during the fumigation treatments or immediately afterwards because the photosynthetic rate usually returns to the prefumigation level within 24 hours, if no injury is present. The mechanism or mode of action by which pollutants reduce photosynthesis is still not completely understood. It appears to involve one or more of the following: modification of stomata activity; degradation of chlorophyll; disruption of cell membranes and chloroplast; or inhibition of enzyme activity. 50 refs.

24920 (CFS/OO–46-13/35-1991E, pp. 153-169) **Sensitivity of forest plant reproduction to acid rain.** Cox, R.M. (Toronto Univ., ON (Canada)). Canadian Forestry Service, Ottawa, ON (Canada). 1991. (CONF-8306311–: Effects of acid rain on forest resources, Sainte-Foy (Canada), 14-17 Jun 1983; MICROLOG–92-03656). In *Effects of acid rain on forest resources: Proceedings.* 667p. Source: PC Forestry Canada, Place Vincent Massey, 351 St. Joseph Blvd., Ottawa, ON, CAN K1A 1G5; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1 PC PRICES UPON REQUEST; MF $10 CAN.

The relevance of long range transported air pollutants to, and their effects on, reproductive processes of forest and native flora are reviewed and discussed. Included are some effects of ozone and sulfur dioxide as they relate to acid deposition or to combined effects with acidic deposition. In vitro and in vivo experiments that investigate the effects on pollen of acidic and trace element components of polluted rain are described. The in vitro pollen sensitivity to pH was related to canopy strata and plant taxon together with, in one instance, the soil type of the population from which it was collected. Most pollen assayed revealed that its threshold of response to pH is exceeded by the pH recorded for daily rain samples collected at one rural site in southern Ontario. The in vitro effects on pollen of cadmium and aluminum in combination with pH are discussed in relation to cation stimulation of pollen and to synergistic interaction with pH, respectively. In vivo inhibition of pollen function by field simulations of acid rain on Oenothera parviflora is compared to similar inhibition by SO_2 fumigations, which have reduced seed set in some species. Given some evidence for correlations between tolerances of the pollen and their sporophytes, the possible effects of direct environmental selection of pollen genotypes on the stigmatic surface by air pollution are discussed with reference to fitness for future generations. 48 refs., 4 figs., 5 tabs.

24921 (CFS/OO–46-13/35-1991E, pp. 112-120) **Physiological and biochemical effects of acid deposition on forest vegetation.** Treshaw, M. (Utah Univ., Salt Lake City, UT (United States)). Canadian Forestry Service, Ottawa, ON (Canada). 1991. (CONF-8306311–: Effects of acid rain on forest resources, Sainte-Foy (Canada), 14-17 Jun 1983; MICROLOG–92-03656). In *Effects of acid rain on forest resources: Proceedings.* 667p. Source: PC Forestry Canada, Place Vincent Massey, 351 St. Joseph Blvd., Ottawa, ON, CAN K1A 1G5; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1 PC PRICES UPON REQUEST; MF $10 CAN.

Despite many mechanisms by which acid deposition might directly damage plants biochemically, none has been documented. Strong acids would ionize to form anions and protons. The hydrogen ions briefly accumulating would first render the cell wall region very acidic. This in turn may alter the calcium balance and cause a loosening reaction of the cell wall fibers leading to water imbalance. Any buildup of anions might promote osmotic imbalance. Subsequent reactions of hydrogen ions with membranes are possible, and a significant increase in leaching of potassium, magnesium and calcium ions has been reported following foliage sprays with artificially acidified rain. Although several important plant processes, including potassium balance, carboxylation, ribosome activity, DNA depression and protein synthesis, are thought

to be influenced by hydrogen balance, hydrogen ions may not penetrate the cell sufficiently to affect these processes. The potential effects are more likely a surface phenomena. Cytoplasmic pH values range from ca 7.0 to 8.5 and may be controlled by regulation of the number of carboxyl groups. The buffering capacity of the cell is limited to coping only with short-term fluctuations. The biochemical effects of acid deposition depend on the balance of internal processes producing and consuming H^+ ions. Equilibrium can be maintained only so long as the H^+ ions produced can be neutralized. Should H^+ concentration exceed a certain threshold of tolerance, physiological injury may be expected. The threshold may be related to the capacity of cells to actively exclude H^+ and generally appears to be below pH 3.0 to 4.0. 36 refs., 1 tab.

24922 (CFS/OO–46-13/35-1991E, pp. 466-473) **Resistance of the caribou lichen (Cladina stellaris (Opiz.) Brodo) to growth reduction by simulated acid rain.** Lechowicz, M.J. (McGill Univ., Montreal, PQ (Canada)). Canadian Forestry Service, Ottawa, ON (Canada). 1991. (CONF-8306311–: Effects of acid rain on forest resources, Sainte-Foy (Canada), 14-17 Jun 1983; MICROLOG–92-03656). In *Effects of acid rain on forest resources: Proceedings.* 667p. Source: PC Forestry Canada, Place Vincent Massey, 351 St. Joseph Blvd., Ottawa, ON, CAN K1A 1G5; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1 PC PRICES UPON REQUEST; MF $10 CAN.

Natural mats of C. stellaris growing in the subarctic lichen woodlands of northern Quebec were treated in a randomized complete block design with solutions of simulated rain at pH 2.5, 3.0, 3.5, 4.0, 4.5, 5.0 and 5.6. These solutions were acidified by addition of mixtures of sulfuric and nitric acids to give both 2:1 and 6:1 microequivalent ratios of SO_4^{2-}:NO_3. Treatments were applied weekly during the snow-free season. Measurements of the mean annual growth rate before and after two years of treatment were used to assess the potential effects of acid precipitation on net production of this important caribou forage lichen. Analysis of covariance showed no significant effect of either pH or SO_4:NO_3 ratio on the growth of C. stellaris. This circum-boreal and very abundant lichen appears to be resistant to at least short-term exposures to acid precipitation. 25 refs., 2 figs., 2 tabs.

24923 (CFS/OO–46-13/35-1991E, pp. 597-600) **Does ozone disturb water balance in forest trees in Sweden?.** Skarby, L. (Swedish Environmental Research Inst., Gotheburg (Sweden)); Berglind, B. Canadian Forestry Service, Ottawa, ON (Canada). 1991. (CONF-8306311–: Effects of acid rain on forest resources, Sainte-Foy (Canada), 14-17 Jun 1983; MICROLOG–92-03656). In *Effects of acid rain on forest resources: Proceedings.* 667p. Source: PC Forestry Canada, Place Vincent Massey, 351 St. Joseph Blvd., Ottawa, ON, CAN K1A 1G5; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1 PC PRICES UPON REQUEST; MF $10 CAN.

A study was carried out to determine whether ozone affects the stomatal mechanism in conifers in such a way that the transpiration rate is disturbed. This could affect the ability of the tree to maintain its water balance, especially during a drought period. Scots pine (Pinus sylvestris L.) seedlings were exposed for six weeks to simulated ozone levels and episodes (80-240 $\mu g/m^3$) typical of those occurring on the Swedish west coast every summer. Afterwards, seedlings were subjected to water stress. Photosynthesis and transpiration were measured periodically. It was found that photosynthesis rate was not affected. The ozone levels and transpiration rates of both control and exposed seedlings during the entire experimental period are presented. Accumulated water loss during the six week period was 110 g/g (dry weight) in the exposed seedling and 100 g/g in the control. 2 refs., 2 figs.

24924 (CIEMAT–704) **ARIES: Further description of its assessment process.** Rabago, I.; Sierra, I.; Vidania, R. Centro de Investigaciones Energeticas, Medioambientales y Tecnologicas (CIEMAT), Madrid (Spain). 1993. 37p. (In Spanish). Order Number DE93796620. Source: OSTI; NTIS.

ARIES is an integrated system designed in order to facilitate the effects assessment produced by accidental release of toxic chemicals. ARIES has been developed for inhalation exposures to estimate short term consequences over the exposed population. ARIES works with mathematical algorithms and is complemented with an additional system that executes the selection of relevant information, giving and additional support to the assessment. ARIES Methodology is based, on one side, in the development of a system of mathematical models joint sequentially in order to obtain a quick answer about the severity of the expected human effects as a function of the toxic concentration released to the environment (Quantitative process), and on the other side in the analysis and optimisation of the contrasted existing information about chemicals toxicity (Qualitative process). Both processes are sequential and complementary. ARIES methodology is physically supported by an informatic system. ARIES works with relational databases and mathematical algorithms programmed in dbase/sql language which let relate the above process, and furthermore add or incorporate progressively new models or complementary information. It has been developed a first prototype PC's of ARIES including several products of 82/505/EEC Directive. In a previous report we described the systems as a whole, and specially, their qualitative step. This report is directed to describe the quantitative assessment process of the system, specifically those aspects included in the present version of the prototype. Developed parts of quantitative steps are designed for situations in which only basic data like TLV's, DL, etc., are available for the assessment.

24925 (CONF-9308105–1) **Evaluation of possible biological effects from exposure to gaseous SF_6 breakdown products.** Griffin, G.D.; Sauers, I.; James, D.R. Oak Ridge National Lab., TN (United States). [1993]. 5p. Sponsored by USDOE, Washington, DC (United States); Electric Power Research Inst., Palo Alto, CA (United States); Tennessee Valley Authority, Knoxville, TN (United States); Empire State Electric Energy Research Corp., New York, NY (United States); Nationa DOE Contract AC05-84OR21400. From 8. international symposium on high voltage engineering; Yokohama (Japan); 23-27 Aug 1993. Order Number DE93013210. Source: OSTI; NTIS; INIS; GPO Dep.

A variety of chemical byproducts including SOF_2, SO_2F_2, SF_4, HF, SO_2, etc. are produced at varying concentrations by electrical arcs, sparks or corona discharge in SF_6; most of the byproducts are toxic to some degree. Using a cell culture system, we have studied the toxicity of individual byproduct gases, as well as electrically decomposed SF_6. The toxic potency of various byproducts can be compared, using this cellular assay. The animal toxicological data for these gases, although sparse, is also reviewed. The rationale for selection of various byproduct gases as monitors for evaluating the hazard potential of decomposed SF_6 is discussed.

24926 (DOE/ER/60572–T2) **Effects of pesticides on crab cheliped regeneration: Final report.** Costlow, J.D. Jr. Duke Univ., Durham, NC (United States). [1993]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG05-87ER60572. Order Number DE93015089. Source: OSTI; NTIS; GPO Dep.

The mud crab cheliped regeneration bioassay has proven to be a sensitive and reliable bioassay in studies of the potential sublethal effects of pesticides, including teratogenesis, spontaneous autotomy, and duration of the various stages of development. The assay has also been demonstated to be a useful indication of mortality associated with the impact of these chemicals of anthropogenic origin during the megalopal and early postlarval stages of development. Four pesticides were tested here using the cheliped regeneration bioassay technique. Although carbofuran is approximately 5–6 times more toxic than methomyl, both compounds yield very similar results in terms of sublethal effects.

24927 (DOE/ER/60964–4) **New fluorescence methodology for detecting DNA adducts: Progress report, May 1, 1991–May 21, 1993.** Giese, R.W. Northeastern Univ., Boston, MA (United States). 21 May 1993. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-90ER60964. Order Number DE93015097. Source: OSTI; NTIS; GPO Dep.

A new reagent, BO-IMI, has been developed that achieves, single step, phosphate specific fluorescence labeling under aqueous conditions. Both 3 in. and 5 in. mononucleotides, including representative DNA adducts can be labeled. Included in this technique is a convenient procedure for postlabeling sample cleanup, leading to a practical detection of the products by capillary electrophoresis with laser fluorescencedetection. We consider that this new method will have a significant impact on the measurement of DNA adducts

in human samples. This work was largely accomplished in the second half of our project. In the first half, we set up a new way to isolate DNA nucleotides from blood, worked with an initial, less specific technique for labeling DNA adducts, compared ionizing radiation vs oxidative damage to fluorescein labeled deoxyadenylic acid, and set up a capillary electrophoresis laser fluorescence detection system.

24928 (ETDE/ES-mf–93796610) **Metallothionein as a biological indicator in rats exposed to inorganic mercury.** Morcillo Alonso, M.A. Universidad Autonoma de Madrid (Spain). 1992. 137p. (In Spanish). Order Number DE93796610. Source: OSTI; NTIS.

Groups of Sprague-Dawley rats were exposed to 0,1; 1, 10 and 100 pmm of mercury (as mercuric chloride) in the drinking water for 8 weeks and then were injected intraperitoneally with $^{203}HgCl_2$ three hours prior to sacrifice. Kidney and liver were removed, homogenized and centrifugated at 105.000 g. The supernatant obtained was applied to a Sephadex G-75 column and the ^{203}Hg content in each fraction was determined by gamma-spectrometry. The fractions with Ve/Vo=1,6-2,1 were used for quantitative analysis of the metallothionein (indirect determination via SH-groups) and metals content (Cu, Zn and Hg; atomic absorbance spectrophotometry). The dietary mercury induces an significant increase in renal MT of rats exposed to 10 and 100 ppm. In contrast, no induction of MT was observed in the liver of mercury-exposed rats, neither an increase in urinary excreted MT. Renal MT appears to play a role in the binding of mercury when this is present at low concentrations whereas the hepatic MT does not bind a significant amount of this element at these levels of exposure. There was a strong positive correlation between mercury and copper levels associated to renal MT. The metal composition of MT was: Cu_4,Zn_2;-MT (control group); Cu_5,Zn_3,-MT (group exposed to 0,1 ppm); Cu_6,Zn_6,Hg_1-MT (group exposed to 1 ppm); Cu_8,Zn_4,Hg_3-MT (group exposed to 10 ppm) and Cu_10,Zn_1,Hg_4-MT (group exposed to 100 ppm). (author). 148 refs., 32 figs.

24929 (ETDE-mf–93795280) **Bayreuth Institute of Terrestrial Ecosystem Research (BITOEK). Interim report 1991.** Bayreuther Inst. fuer Terrestrische Oekosystemforschung (BITOEK), Bayreuth (Germany). [1992]. 236p. (In German). Contract OEF 2029;BMFT 0339476A. Order Number DE93795280. Source: OSTI; NTIS (US Sales Only).

This annual interim report of 'BITOeK' deals with topical results of research at the institute in the four subject areas 'cycles of substances', 'substance degradation', 'ecology of population', and 'turnover of substances in plants'. A focus is on soil chemistry and biology and the changes they undergo because of environmental pollution. In particular, the interest of the research groups centres on the nitrogen budget of soil, plants (spruces), and the entire ecosystem (deposition, discharge, turnover), the water and ion budget of forest soils, the activity of soil microorganisms under the influence of different environmental chemicals, and the consequences of soil acidification. (UWA).

24930 (LA–12346-MS) **Preliminary toxicology study of 3,6-diamino-1,2,4,5-tetrazine.** London, J.E. Los Alamos National Lab., NM (United States). Mar 1993. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. Order Number DE93009117. Source: OSTI; NTIS; GPO Dep.

The calculated acute oral LD 30/50 (lethal dose for 50% of the animals occurring within 30 days after compound administration) value for 3,6-diamino-1,2,4,5-tetrazine (DATZ) was 863 mg/kg in rats. According to classical guidelines, DATZ would be considered slightly to moderately toxic for rats. The calculated acute oral $LD_{30/50}$ value was 2,288 mg/kg in mice and would be considered slightly to moderately toxic for mice. Skin application studies using rabbits demonstrated DATZ to be a nonirritant. The eye study using rabbits disclosed DATZ to be a very mild irritant. The sensitization study using guinea pigs did not show DATZ to have potential sensitizing properties.

24931 (ORNL/FTR–4230) **Participation in the European research conference on effects of elevated CO_2 levels, air pollutants and climate change on natural plant ecosystems: Foreign trip report, March 30–April 13, 1992.** Norby, R.J. Oak Ridge National Lab., TN (United States). 23 Apr 1992. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93011291. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The traveler attended the European Research Conference, presented a poster, and participated in the roundtable discussion. The conference was the first in what is to be a series of meetings every two years on the effects of elevated CO_2 and air pollutants on tree physiology. The presentations at the conference showed the increasing level of interest in CO_2 effects within the European research community. The conference provided a useful forum for discussing how the research programs can be directed toward the most fruitful d important areas.

24932 (ORNL/FTR–4300) **Travel to Luso, Portugal, to participate in a NATO Advanced Study Institute workshop on the use of biomarkers in assessing health and environmental impacts of chemical pollutants: Foreign trip report, May 29, 1992–June 10, 1992.** Travis, C.C. Oak Ridge National Lab., TN (United States). 24 Jun 1992. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93011076. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The traveler attended and directed a NATO Advanced Study Institute Workshop on the Use of Biomarkers in Assessing Health and Environmental Impacts of Chemical Pollutants. The objective of the workshop was to develop a conceptual framework for the use of biomarkers in the assessment of human and environmental health, to review the current state of knowledge of biomarkers, and to formulate the research needs for implementation and interpretation of biological monitoring programs to define community health problems.

24933 (PNL–8650-Pt.1) **SNODOG Glossary: Part 1, Introduction.** Watson, C.R. Pacific Northwest Lab., Richland, WA (United States). 15 Apr 1993. 93p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93013502. Source: OSTI; NTIS; GPO Dep.

The SNODOG Glossary is used by the DOE-supported life-span beagle studies to describe medical observations in a standardized format. It is an adaptation of the human medical glossary, SNOMED, which lists 107,165 terms. Each of the five laboratories, Argonne National Laboratory, the Inhalation Toxicology Research Institute, the Pacific Northwest Laboratory, the University of California at Davis, and the University of Utah, has selected an appropriate subset from the published SNOMED glossary and added beagle and research-specific terms. The National Radiobiology Archives is the coordinator of these enhancements, and periodically distributes SNODOG to the respective laboratories. Information donated by Colorado State University and Oak Ridge National Laboratory has been related to SNODOG and is available in a standardized format. This document is designed for the database manager and the scientist who will be managing or coding medical observations. It is also designed for the scientist analyzing coded information. The document includes: an overview of the NRA and the SNODOG glossary, a discussion of hardware requirements, a review of the SNODOG code structure and printed lists of the 4,770 terms which have been used at least once. Instructions for obtaining electronic copies of the glossary and for nominating additional terms are provided. This document describes the origins and structure of the SNODOG codes, explains code usage at each participating institution, and presents a usage frequency tabulation of the terms for neoplasia. A diskette or magnetic tape containing 15,641 SNODOG codes and translations is available on request.

5604 Other Environmental Pollutant Effects

Refer also to citation(s) 23311

57 HEALTH AND SAFETY

Refer also to citation(s) 23135, 23136, 23146, 23635, 23731, 23732, 23799, 23870, 24092, 24127, 24143, 24504, 24505, 24510, 24511, 24517, 25380

24934 (ANL/EAIS/CP–79014) **Geographic Information System (GIS) applications in emergency management.** Newsom, D.E.; Mitrani, J.E. Argonne National Lab., IL (United States). Environmental Assessment and Information Sciences Div. [1993]. 2p. Sponsored by USDOE, Washington, DC (United States); Federal Emergency Management Agency, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-930372–8: 1993 international simulators conference on high performance computing, Arlington, VA (United States), 29 Mar - 1 apr 1993). Order Number DE93009984. Source: OSTI; NTIS; GPO Dep.

One of the most useful and readily available technologies to aid emergency managers is the geographic information system (GIS). The potential usefulness of GIS is indicated by many of the papers presented in this conference. This paper will discuss two of the authors' experiences with a GIS in combination with simulation models, and will present an overview of other GIS applications.

24935 (ANL/ESH/CP–78903) **Emergency exercise methodology.** Klimczak, C.A. Argonne National Lab., IL (United States). [1993]. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-9303113–1: Hazmat central conference, Chicago, IL (United States), 9-11 Mar 1993). Order Number DE93009132. Source: OSTI; NTIS; GPO Dep.

Competence for proper response to hazardous materials emergencies is enhanced and effectively measured by exercises which test plans and procedures and validate training. Emergency exercises are most effective when realistic criteria is used and a sequence of events is followed. The scenario is developed from pre-determined exercise objectives based on hazard analyses, actual plans and procedures. The scenario should address findings from previous exercises and actual emergencies. Exercise rules establish the extent of play and address contingencies during the exercise. All exercise personnel are assigned roles as players, controllers or evaluators. These participants should receive specialized training in advance. A methodology for writing an emergency exercise plan will be detailed.

24936 (BNL–48481) **Assessment of needs and requirements for a geographic information system for Brookhaven National Laboratory.** Baxter, S.L.; Daum, M.L.; Scott, A. Brookhaven National Lab., Upton, NY (United States). 19 Nov 1992. 36p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. Order Number DE93009260. Source: OSTI; NTIS; GPO Dep.

At the request of the Brookhaven National Laboratory Office of Environmental Restoration, and with the cooperation of the Safety and Environmental Protection and Plant Engineering Divisions, a Geographic Information System (GIS) Task Group has undertaken an effort to identify the data requirements, potential applications, and computing environment within which an integrated GIS could be implemented to meet the environmental and facilities management needs of the Laboratory. The Task Group held discussions with the three participating groups and with Laboratory officials. Software and hardware vendors were invited to demonstrate their products to all participants using BNL data, and private consultants discussed their GIS and database applications. After considering the needs of the three groups and other general implementation concerns, a list of ten requirements for a BNL site-wide GIS has been determined. On the basis of these considerations, three conceptual models for an integrated GIS are defined. These include a highly centralized system, a fully distributed system, and a composite model. The models differ in their allocation of responsibility for data management, applications development and GIS analysis, and local user support. Several issues remain to be resolved before an integrated GIS for the three operational groups can be fully implemented.

24937 (CONF-921275–, pp. 17-18) **Reactivity of sodium azide.** Sakumoto, K. (Kyushu Institute of Technology, Kitakyushu (Japan). Faculty of Engineering); Hara, Y.; Nakamura, H.; Ochi, K. 2 Dec 1992. 160p. (In Japanese). From 25. safety engineering study meeting; Kitakyushu (Japan); 2-3 Dec 1992. In *Proceedings of the 25th Safety Engineering Study Meeting.* Order Number DE93793904. Source: OSTI; NTIS (US Sales Only).

This paper studies reactivity of sodium azide used as gas generating main agent for automobile air bags, rockets, and lifesaving equipment. Powder sodium azide causes an exothermic reaction under 460°C controlled atmosphere with a sharp decline in weight. Pelleted sodium azide causes the same reaction around 400°C, which means that forming sodium azide powder into pellets accelerates the reaction. Under Ar, N, air, and He atmosphere normal pressure, a peak of exothermic temperature moves to a higher temperature side as the gas increases in thermal conductivity. It moves to a lower temperature side when pressurized. As milling time increases, a peak temperature of the differential thermal analysis decreases. There is no deterioration with age in inert nitrogen gas, but a decrease in purity by 5-8% is seen in oxygen and CO2. Under the CO2 plus steam atmosphere, purity reduces to 47% 48 hours later because of formation of sodium hydrogen carbonate. Any other gases except nitrogen reduce their decomposition initiation temperatures. 4 figs.

24938 (CONF-921275–, pp. 19-22) **Reactivity of activated carbon which adsorbed exhaust gas from the semiconductor production process.** Fukunaga, A. (Ebara Research Co. Ltd., Kanagawa (Japan)); Ito, H.; Mori, Y.; Matsumura, C.; Iida, M.; Tanaka, K.; Kondo, S. 2 Dec 1992. 160p. (In Japanese). From 25. safety engineering study meeting; Kitakyushu (Japan); 2-3 Dec 1992. In *Proceedings of the 25th Safety Engineering Study Meeting.* Order Number DE93793904. Source: OSTI; NTIS (US Sales Only).

The paper studies reactivity of activated carbon which adsorbs exhaust gas from the semiconductor production process in which gas including F, N, and O is made plasmatic for treatment. Plasma gas adsorption carbon adsorbs NO2, FNO, FNO2 and F2, and causes self-reaction and generates heat even at a temperature of several tens°C. The gas attains a considerably high temperature by itself, depending on the amount of adsorption. Mainly NO2 relates to this reaction. When the temperature is raised up to 400°C, the gas reacts abruptly and this reaction seems to be caused by F2 absorbed in graphite layers of activated carbon. In case of contacting it with materials easily oxidized such as alcohol, the activated carbon reacts and generates heat at a normal temperature. Accordingly, such exhaust gas adsorbing activated carbon starts to react from relatively low temperatures depending on the situation, and is in danger of causing a rapid pressure increase. There is no danger in chlorine-base and bromine-base gases. 1 ref., 4 figs., 1 tab.

24939 (CONF-921275–, pp. 33-34) **Danger identifying power.: Difference between aged and young persons.** Sato, Y. (Tokyo University of Mercantile Marine, Tokyo (Japan)); Usui, S. 2 Dec 1992. 160p. (In Japanese). From 25. safety engineering study meeting; Kitakyushu (Japan); 2-3 Dec 1992. In *Proceedings of the 25th Safety Engineering Study Meeting.* Order Number DE93793904. Source: OSTI; NTIS (US Sales Only).

Labor shortage and worker's age advancing have become a problem in work sites. Accordingly, an experiment was carried out on how aged persons can identify a danger. Four danger prediction training sheets were used for a danger identifying test. For example, the sheet No. 1 depicts four workers trying to lift a propane gas bomb to a second floor by pulling up a belt passed through holes on a lid of the bomb. The subjects included aged male persons as old as from 61 to 76 years of age, female persons from 57 to 72 years old, and young persons from 21 to 23 years old. They were directed to view the sheets and describe as many accident scenarios as possible in ten minutes. Then, accident finding check lists previously prepared were distributed, and the subjects were requested to write statements again. The aged female subjects showed a remarkable effect from the check lists, with the final number of accident finding exceeding considerably that of the male subjects. The number in the young persons exceeded that in the aged persons in all the cases by about 50%. A considerable fall in the identifying power was recognized in the aged persons. 1 fig., 1 tab.

24940 (CONF-921275–, pp. 35-38) **Safety analyzing method with emphasis on operants (objects of work).: Especially when applied to repair work and material handling work.** Takahashi, T. 2 Dec 1992. 160p. (In Japanese). From 25. safety engineering study meeting; Kitakyushu (Japan); 2-3 Dec 1992. In

Proceedings of the 25th Safety Engineering Study Meeting. Order Number DE93793904. Source: OSTI; NTIS (US Sales Only).

This paper introduces a safety analyzing method called a (4 + 3)×3 analysis. Conventional work systems have identified works as comprising persons, materials, and works, wherein machines and environment were the main objects for the materials. Conceptions on causes in disaster cause analysis can be classified largely into machines, environments, and objects (materials and commodities), from which one item has been selected as a most important item. However, safety anticipation requires recognition of coexistence of elements and an analysis placing emphasis on operants (objects receiving works). The (4 + 3)×3 analysis extracts safety check points on contact points from various combinations of three functions represented by the four elements comprising people, machines, objects, and environment, the energy, the information, and the approach and contact of three elements (people, machines, and objects) at beginning and end of a work and during a process flow. The analysis uses these check points as a clue to determining problems. The system covers not only people, machines, and materials (objects) independently, but also all the combinations such as people with machines, machine with materials, and materials with environment. 3 figs., 1 tab.

24941 (CONF-921275–, pp. 39-42) **Probability of occurrence of industrial disasters.: Its changes and future prediction.** Hasegawa, K. (Fire Research Institute, Tokyo (Japan)). 2 Dec 1992. 160p. (In Japanese). From 25. safety engineering study meeting; Kitakyushu (Japan); 2-3 Dec 1992. In *Proceedings of the 25th Safety Engineering Study Meeting.* Order Number DE93793904. Source: OSTI; NTIS (US Sales Only).

This paper presents data for occurrence of labor disasters in Japan for the past 40 years, and illustrates a trend that both of frequencies and intensities of the disasters of every kind and in each industry decrease year by year. For example, the disaster occurrence frequency for the whole industry has decreased to 1/20 in 37 years. The future frequency was predicted by extending the regression line obtained from these data. Bases for the prediction to be possible include that the prediction values and their reliability zones can be calculated under a reliability (95%), the prediction is very little affected from extraordinary past events in the national economy (including the oil crises), and safety technologies will continue developing, as one of the future factors. The frequency of labor disasters in the whole industry in 1952, 1989, and 2000 has reduced and will reduce from 43.6→ 1.81→ 0.772, and the intensity from 4.59→ 0.179→0.076. 4 refs., 6 figs., 2 tabs.

24942 (EGG-M–92571) **Accrediting industrial safety training programs.** Beitel, L. EG and G Idaho, Inc., Idaho Falls, ID (United States). [1992]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-76ID01570. (CONF-921187–5: 16. training resources and data exchange: managing for performance and results, Seattle, WA (United States), 2-4 Nov 1992). Order Number DE93013669. Source: OSTI; NTIS; INIS; GPO Dep.

There are job-specific training requirements established by regulations that Impose stringent training requirements on a contractor, for example, the Occupational Safety & Health Act (OSHA). Failure to comply with OSHA training requirements can result in severe penalties being levied against a company. Although an accredited training program is expensive, it is a possible solution for minimizing risks associated with job-specific training requirements for employees. Operating DOE contractors direct approximately 10 percent of the operating funds toward training activities. Training needs for contractors span a broad range, from requirements awareness training for managers, to general training required on a one-time basis for all employees, to highly specialized training programs for employees involved In clean-up operations at hazardous waste sites. With this kind of an investment in training, it is logical to maximize the most return on an investment of training funds and to limit exposure to liability suits whenever possible. This presentation will provide an overview of accredited industrial safety programs. The criteria for accredited industrial safety programs will be defined. The question of whether accredited training programs are necessary will be examined. Finally, advantages and disadvantages will be identified for accrediting industrial safety training programs.

24943 (ORNL/FTR–4545) **[Travel to France to participate in the 10th workshop of the scientific group on methodologies for the safety evaluation of chemicals]: Foreign trip report, March 5–15, 1993.** Barnthouse, L.W. Oak Ridge National Lab., TN (United States). 31 Mar 1993. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93011821. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report summarizes a trip by L. W. Barnthouse of the Environmental Sciences Division (ESD), Oak Ridge National Laboratory (ORNL), to Montpellier, France, where he participated in the 10th Workshop of the Scientific Group on Methodologies for the Safety Evaluation of Chemicals. The topic of this workshop was Effects of Chemicals on Ecosystems. Dr. Barnthouse wrote a discussion paper on ecological risk assessment and participated in a discussion/writing group on assessment of regional-level effects of chemicals.

24944 **False color viewing device.** Kronberg, J.W. To Dept. of Energy. 8 May 1991. USA patent application 7-697,158. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE93012003. Source: OSTI; NTIS; GPO Dep.

This invention consists of a viewing device for observing objects in near-infrared false-color comprising a pair of goggles with one or more filters in the apertures, and pads that engage the face for blocking stray light from the sides so that all light reaching, the user's eyes come through the filters. The filters attenuate most visible light and pass near-infrared (having wavelengths longer than approximately 700 nm) and a small amount of blue-green and blue-violet (having wavelengths in the 500 to 520 nm and shorter than 435 nm, respectively). The goggles are useful for looking at vegetation to identify different species and for determining the health of the vegetation, and to detect some forms of camouflage.

24945 (PNL–8574) **Evaluation of S-101 course "Supervisors' Orientation to Occupational Safety in DOE" taught in Las Vegas, Nevada, October 26–29, 1992.** Wright, T.S. Pacific Northwest Lab., Richland, WA (United States). Mar 1993. 20p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93010359. Source: OSTI; NTIS; GPO Dep.

This report summarizes trainee evaluations for the Safety Training Section course, "Supervisors' Orientation to Occupational Safety in DOE", (S-101) which was conducted October 26–29, 1992 at EG&G Measurement, in Las Vegas, Nevada. Sections 1.1 and 1.2 of this report summarize the quantitative course evaluations that trainees provided upon completion of the course. Sections 2.0 and 3.0 provide examination results, and recommendations for improvement. Appendix A provides a transcript of the trainees' written comments and Appendix B presents a copy of the course evaluation form that students were asked to complete.

24946 (PNL-SA–21968) **Occupational injury and illness recordkeeping.** Pacific Northwest Lab., Richland, WA (United States). [1993]. 30p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93013454. Source: OSTI; NTIS; INIS; GPO Dep.

This manual was prepared to accompany a course to train managers in proper recordkeeping procedures as required by DOE Orders and OSHA guidelines.

24947 (UCRL-ID–112719) **The impact of horizontal resolution on moist processes in the ECMWF model.** Phillips, T.J.; Corsetti, L.C.; Grotch, S.L. Lawrence Livermore National Lab., CA (United States). Jan 1993. 39p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (PCMDI–8). Order Number DE93011718. Source: OSTI; NTIS; GPO Dep.

Summer and winter climates simulated at spectral scales T21, T42, T63 and T106 with the ECMWF model are analyzed to determine the impact of changes in horizontal resolution on atmospheric water vapor, clouds, convection, and precipitation. Qualitative

changes in Pi many moist processes occur in the transition from spectral T21 to T42, especially in the tropics where atmospheric convection plays a central role. However, the seasonal climate simulations do not show evidence of convergence to an asymptotic climate state at high resolution. Global convective precipitation increases monotonically with resolution, but frontal precipitation, precipitable water, and cloud cover display a qualitatively different pattern; after undergoing abrupt reductions in the transition from T21 to T42, their global averages show relative increases at finer resolutions. Precipitable water and cloud cover also display a seasonal asymmetry in their responses to increasing resolution.The comparative insensitivity of global cloud cover to resolution is mainly a consequence of compensating tendencies of clouds in different regions. With increasing resolution, decreases in lowlatitude clouds that result from drying of the tropical atmosphere are partially offset by increases in high-latitude clouds associated with enhanced relative humidity in response to an intensifying extratropical cold bias. The large-scale tropical moist processes are modeled more realistically at T21 than in the finer-resolution simulations, wherein anomalous seasonal climatic features such as a double ITCZ and underdeveloped summer monsoon circulation are evident. Although some of these anomalies might ameliorate if the physical parameterizations were suitably "tuned," these deficiencies may reflect more fundamental problems related to a mismatch between the resolution of the model and the implicit spatial and temporal scales of the parameterizations.

5701 Real Accidents

Refer also to citation(s) 22773, 22774, 22775, 23539, 23800, 23801, 23802, 23871, 24129, 24509, 24512, 24513, 24516, 24871

58 GEOSCIENCES

Refer also to citation(s) 22784, 22786, 22792, 22848, 22916, 22921, 22930, 22990, 22999, 23001, 23003, 23011, 23012, 23031, 23036, 23037, 23039, 23040, 23041, 23043, 23044, 23057, 23073, 23107, 23128, 23305, 23677, 23728, 23729, 24273, 24595, 24643, 24646, 24648, 24653, 24654, 24656, 24754, 24755, 24756, 24794, 24810, 24837, 25392

24948 (ANL/ES/CP–77790) **Integrated, flexible, and rapid geophysical surveying.** Miller, S.F.; McGinnis, L.D.; Thompson, M.D.; Tome, C. Argonne National Lab., IL (United States). [1993]. 17p. Sponsored by USDOE, Washington, DC (United States); Department of Defense, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-9304109–1: SAGEEP '93: symposium on the application of geophysics to environmental and engineering problems, San Diego, CA (United States), 18-21 Apr 1993). Order Number DE93009989. Source: OSTI; NTIS; INIS; GPO Dep.

Aberdeen Proving Ground (APG), in the state of Maryland (Figure 1), is currently managing a comprehensive Installation Restoration Program involving more than 360 solid-waste managing units contained within 13 study areas. The Edgewood area and two landfills in the Aberdeen area appear on the National Priority List under the Comprehensive Environmental Response, Compensation, and Liability Act. Therefore, APG has entered into an interagency agreement with the US Environmental Protection Agency to address the listed areas. The West Branch of the Canal Creek area (Figure 1), located within the Edgewood area, is one of the areas that requires a Source Definition Study because there is an ongoing release of volatile organic compounds into the creek. A report prepared by EAI Corporation (1989) included a list of 29 potentially contaminated buildings in the Edgewood area. Sixteen of the buildings contain known contaminants, nine buildings contain unknown contaminants, and four of the buildings are potentially clean. The EAI report recommended that a sampling and monitoring program be established to verify contamination levels in and around each building. Thirteen of the potentially contaminated buildings are in the West Branch of the Canal Creek area and are potential sources of volatile organic compounds. Operations have ceased and the buildings have been abandoned, but processing equipment, sumps, drains, ventilation systems, and underground storage tanks remain. These appurtenances may contain liquid, solid, or vapor contaminants of unknown nature.

24949 (ANL/MCS-TM–171) **A toolkit for building earth system models.** Foster, I. Argonne National Lab., IL (United States). Mathematics and Computer Science Div. Mar 1993. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. Order Number DE93012147. Source: OSTI; NTIS; GPO Dep.

An earth system model is a computer code designed to simulate the interrelated processes that determine the earth's weather and climate, such as atmospheric circulation, atmospheric physics, atmospheric chemistry, oceanic circulation, and biosphere. I propose a toolkit that would support a modular, or object-oriented, approach to the implementation of such models.

24950 (DOE/ER/13978–4) **Organic Geochemical and tectonic evolution of the Midcontinent Rift system: Final report.** Hayes, J.M. (Indiana Univ., Bloomington, IN (United States)); Pratt, L.M.; Knoll, A.H. Indiana Univ., Bloomington, IN (United States). [1992]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-88ER13978. Order Number DE93015093. Source: OSTI; NTIS; GPO Dep.

The older assemblages stand in contrast with the ca. 1000 Ma old Hunting Formation, Arctic Canada, which contains what may be the oldest evidence for modern algae - red algal fossils that compare closely with members of the extant family Bangiophyceae (Butterfield et al., 1990). Taken together the Nonesuch, Shaler, Hunting and other assemblages support the hypothesis of a major episode of eukaryotic diversification ca. 1000 Ma ago. Prior to this time, eukaryotic primary producers must have been physiologically primitive (and now extinct) algae whose abundance in ecosystems is poorly constrained by analogies with the present oceans. Cyanobacteria were major primary producers in a wide range of marine environments. After 1000 Ma, diversifying red green and chromophyte algae contributed significantly to primary production in all save microbial mat communities in restricted environments. It bears mention that such mat communities remained significant potential sources of buried organic matter until the end of the Proterozoic, necessitating exploration strategies that differ from those commonly employed for younger rocks (Knoll, in press). As in Phanerozoic basins, petroleum exploration in Proterozoic rocks requires tools for stratigraphic correlation. In Neoproterozoic (<1000 Ma) rocks, biostratigraphy is possible, and it is aided significantly by C and Sr isotopic chemostratigraphy. New data from the Shaler Group contribute to the construction of C and Sr isotopic curves for Neoproterozoic time, making possible much improved chronostratigraphy for this time interval. (Asmerom et al., 1991; Hayes et al., ms. in preparation).

24951 (DOE/FTR–93011425) **Travel to Bermuda to attend meetings of the JOIDES Panel Chairs Committee and the JOIDES Planning Committee for discussion of the Ocean Drilling Program: Foreign trip report, November 30–December 5, 1992.** Lysne, P. Sandia National Labs., Albuquerque, NM (United States). 21 Dec 1992. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. Order Number DE93011425. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The Ocean Drilling Program is an international consortium instituted to explore the sub-sea portion of the earth's crust. Support comes from the US National Science Foundation (about 60%) and from member nations. Work within the Ocean Drilling Program parallels that in land-based programs such as the DOE-supported US Continental Scientific Drilling Program and the German Knontinentale Tiefbohrprogramm (KTB). All scientific drilling programs are suffering from a lack of monies directed toward drilling and logging technology, and this situation is exacerbated by the decline in research within the world-wide drilling and logging industries. Cooperative efforts between scientific programs are a possible way to move forward, but these efforts are hampered by lack of an appropriate infrastructure. The organizational model presented by the ODP functions well in its role to promulgate scientific efforts, and it may serve as a model for inter-program thrusts that involve large monetary expenditures, legal responsibilities, and intellectual property rights. A set of specific action items is put forth to explore the envelope presented by the ODP infrastructure. Many of these

items are founded in, and are in direct support of efforts that are under active consideration by the US Continental Scientific Drilling Program.

24952 (ETDE/JP-mf–93794512, pp. 182-187) **Petrophysics and elastic wave technology for evaluation of rock properties.: Development of data analysis technique (impedance and interval velocity inversion).** Ogita, S. (Japan National Oil Corp., Tokyo (Japan)); Shimizu, N.; Matsuoka, T. Japan National Oil Corp., Tokyo (Japan). 30 Oct 1992. 537p. (In Japanese). In *Record of TRC's activities in the fiscal year 1991.* Order Number DE93794512. Source: OSTI; NTIS (US Sales Only).

The Technology Development Center of Japan National Oil Corporation is studying methods to derive underground impedance structures with high accuracy as a sub-theme of the development program for property analyzing seismic exploration technology that began in 1989. This paper is a 1991 annual report for the study. Algorithms was developed by the end of the previous fiscal year to infer underground impedance distribution from seismic records after assemblage and migration using the generalized linear inversion (GLI) method. In the present fiscal year, these algorithms were used to perform case studies in Mexico Bay and the Kanazawa area in Hokkaido, Japan, to extract problems and improve the program. For instance, the model base inversion was reprocessed, and a result was obtained that is more stable than that obtained in the last year, and geologically consistent. The program was further improved in use convenience aspect, from which a dialogue-type seismic inversion system was developed. 3 figs.

24953 (ETDE/JP-mf–93794512, pp. 188-191) **Petrophysics and elastic wave technology for evaluation of rock properties.: Development of data analysis technique (fundamental research on PSP method).** Ogita, S. (Japan National Oil Corp., Tokyo (Japan)); Takahashi, A. Japan National Oil Corp., Tokyo (Japan). 30 Oct 1992. 537p. (In Japanese). In *Record of TRC's activities in the fiscal year 1991.* Order Number DE93794512. Source: OSTI; NTIS (US Sales Only).

This paper is a 1991 annual report on a research which was launched in 1990 as one of the research items in the special research project 'development of property analyzing geophysical exploration methods' at the Technology Development Center of Japan National Oil Corporation. The research aims at making a reflection seismic exploration using S-waves possible by utilizing the fact that P-waves can convert to S-waves at ocean bottom even in a sea water area in which no S-waves can propagate through fluids. Preparing an assemblage cross section chart for wave motions has difficulties in separating wave motions in P-waves and PSSP-waves (P-waves reconverted after having propagated through ground and reflected), and analyzing velocity in the PSSP-waves. As a result of the numerical experiment performed in the fiscal 1991, it was found out that the wave motions can be separated and observed especially clearly in the slowness-time domain. In addition, an indoor experiment using a synthetic resin model provided findings on detection of different converted waves. Further, considerations were given on the NMO correction method using marine seismic exploration data that have been obtained previously in an experiment conducted on the sea off Soma. 3 figs.

24954 (JAB–10733-TM6) **Processed seismic motion records from Little Skull Mountain, Nevada earthquake of June 29, 1992, recorded at stations in southern Nevada.** Lum, P.K.; Honda, K.K. URS/John A. Blume and Associates, Engineers, San Francisco, CA (United States). [1992]. 206p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC08-89NV10733. Order Number DE93005849. Source: OSTI; NTIS; GPO Dep.

For complete package including technical report and 8mm data file, Order No. DE93013314.

As part of the contract with the US Department of Energy, Nevada Field Office (DOE/NV), URS/John A. Blume & Associates, Engineers (URS/Blume) maintains a network of seismographs in southern Nevada to monitor the ground motion generated by the underground nuclear explosions (UNEs) at the Nevada Test Site (NTS). The seismographs are located in the communities surrounding the NTS and the Las Vegas valley. When these seismographs are not used for monitoring the UNE generated motions, a limited number of seismographs are maintained for monitoring motion generated by other than UNEs (e.g. motion generated by earthquakes, wind, blast). During the subject earthquake of June 29, 1992, a total of 20 of these systems recorded the earthquake motions. This report contains the recorded data.

24955 (LA–12534-C) **Proceedings of the first geological materials constitutive modeling workshop.** Swift, R.P.; Snell, C.M. (eds.). Los Alamos National Lab., NM (United States). Apr 1993. 303p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-921265–: 1. geological materials constitutive modeling workshop, Los Alamos, NM (United States), 9-10 Dec 1992). Order Number DE93009161. Source: OSTI; NTIS; GPO Dep.

A workshop on constitutive modeling of geologic materials was held at Los Alamos National Laboratory on 9–10 December, 1992. The workshop was hosted by the Earth and Envirorunental Sciences Division and the Physics Division at the Laboratory. Its purpose was to provide an overview of our current understanding of the dynamic response of geologic materials under saws wave loading, to identify the most important gaps in this understanding, and to define promising experimental approaches for filling the gaps. Particular emphasis was placed on material behavior in the hydrodynamic and strength-dominated regimes for buried explosions, with applications to verification and nonproliferation. These proceedings are a compilation of the brief summary papers and associated view graphs presented at the workshop, along with commentary on modeling and experimental issues addressed in the roundtable discussion session. The papers are printed as submitted by the authors, but have been retyped for format uniformity. In cases where legibility allowed, the view graphs were reduced to half-page size for a more compact document.

24956 (LA-UR–93-856) **Theory of nonlinear elastic behavior in rock.** McCall, K.R. Los Alamos National Lab., NM (United States). [1993]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9306129–1: 13. international symposium on nonlinear acoustics, Bergen (Norway), 28 Jun - 2 jul 1993). Order Number DE93010713. Source: OSTI; NTIS; GPO Dep.

We study plane wave propagation in an isotropic, homogeneous solid with cubic and quartic anharmonicity. Attenuation is introduced through use of a retarded displacement response. We develop a Green function technique to exhibit the solution for the displacement field as a systematic hierarchy in the nonlinear parameters. This solution is applied to three problems: propagation from monochromatic and broadband sources, and the shape of nonlinear stress curves.

24957 (LA-UR–93-1069) **New Mexico Geochronology Research Laboratory: Zuni-Bandera volcanic field road log.** Laughlin, A.W.; Charles, R.; Reid, K.; White, C. Los Alamos National Lab., NM (United States). [1993]. 18p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9304107–1: 1993 quaternary dating field conference, Grants, NM (United States), 27-28 Apr 1993). Order Number DE93010739. Source: OSTI; NTIS; GPO Dep.

This field conference was designed to assemble a group of Quaternary researchers to examine the possibility of using the Zuni-Bandera volcanic field in western New Mexico as a test area for evaluating and calibrating various Quaternary dating techniques. The Zuni-Bandera volcanic-field is comprised of a large number of basaltic lava flows ranging in age from about 700 to 3 ka. Older basalts are present in the Mount Taylor volcanic field to the north. Geologic mapping has been completed for a large portion of the Zuni-Bandera volcanic field and a number of geochronological investigations have been initiated in the area. While amending this conference, please consider how you might bring your expertise and capabilities to bear on solving the many problem in Quaternary geochronology.

24958 (PNL–8539) **Selected hydraulic test analysis techniques for constant-rate discharge tests.** Spane, F.A. Jr. Pacific Northwest Lab., Richland, WA (United States). Mar 1993. 80p. Sponsored by USDOE, Washington, DC (United States). DOE

Contract AC06-76RL01830. Order Number DE93012240. Source: OSTI; NTIS; INIS; GPO Dep.

The constant-rate discharge test is the principal field method used in hydrogeologic investigations for characterizing the hydraulic properties of aquifers. To implement this test, the aquifer is stressed by withdrawing ground water from a well, by using a downhole pump. Discharge during the withdrawal period is regulated and maintained at a constant rate. Water-level response within the well is monitored during the active pumping phase (i.e., drawdown) and during the subsequent recovery phase following termination of pumping. The analysis of drawdown and recovery response within the stress well (and any monitored, nearby observation wells) provides a means for estimating the hydraulic properties of the tested aquifer, as well as discerning formational and nonformational flow conditions (e.g., wellbore storage, wellbore damage, presence of boundaries, etc.). Standard analytical methods that are used for constant-rate pumping tests include both log-log type-curve matching and semi-log straight-line methods. This report presents a current "state of the art" review of selected transient analysis procedures for constant-rate discharge tests. Specific topics examined include: analytical methods for constant-rate discharge tests conducted within confined and unconfined aquifers; effects of various nonideal formation factors (e.g., anisotropy, hydrologic boundaries) and well construction conditions (e.g., partial penetration, wellbore storage) on constant-rate test response; and the use of pressure derivatives in diagnostic analysis for the identification of specific formation, well construction, and boundary conditions.

24959 (SAND–92-1185) **A neural network approach to seismic phase identification.** Draelos, T.J. Sandia National Labs., Albuquerque, NM (United States). Mar 1993. 30p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. Order Number DE93013601. Source: OSTI; NTIS; GPO Dep.

An automatic phase identification system that employs a neural network approach to classifying seismic event phases is described. Extraction of feature vectors used to distinguish the different classes is explained, and the design and training of the neural networks in the system are detailed. Criteria used to evaluate the performance of the neural network approach are provided.

24960 (UCRL-ID–111963) **Application to selected sites of the DG-1015 methodology to determine probabilistic controlling earthquakes.** Bernreuter, D.L. Lawrence Livermore National Lab., CA (United States). Jul 1992. 82p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE93009442. Source: OSTI; NTIS; INIS; GPO Dep.

The NRC requested that LLNL form a group of experts to assist them in the revision of Appendix A to CFR 100. The members of the Expert Group for the revision of Appendix A are listed in Table 1. For the remainder of the report this Expert Group will be simply referred to as the EG. A number of meetings were held with the EG. At the meeting with the EG and NRC, held in Rockville, Maryland, in October 1991, one issue that received considerable discussion was how to best use the probabilistic seismic hazard analysis. Here considerable disagreement developed. Some EG members preferred using a purely probabilistic approach. Others wanted to use a deterministic and probabilistic approach. At the EG meeting in October, Dr. Cornell suggested that in addition to a purely probabilistic approach that there was in the literature an alternative approach that used the probabilistic seismic hazard analysis to determine a hazard-consistent scenario earthquake(s) or a controlling earthquake(s) from the probabilistic analysis (CEPA). The EG agreed that this was a useful concept to explore. NRC requested that LLNL explore this concept and apply it to four test sites given in Table 2. Four other sites were added because EPRI had performed an analysis similar to some of the analyses described in this report thus allowing some comparisons between LLNL and EPRI results. In this brief report, we describe the alternatives and key choices that have to be made. We also provide justification for the tentative choices made that are incorporated into the proposed Appendix B to 10 CFR 100, and Draft Regulatory Guide DG-1015 being sent out for public comment. Further studies are underway to better understand the influence of the choices made and to confirm that the path taken is the best path or to determine if modifications are required.

24961 (UCRL-JC–107852-Rev.1) **Ocean acoustic processing: A model-based approach.** Candy, J.V. (Lawrence Livermore National Lab., CA (United States)); Sullivan, E.J. Lawrence Livermore National Lab., CA (United States); Naval Underwater Systems Center, Newport, RI (United States). Jul 1992. 8p. Sponsored by USDOE, Washington, DC (United States); Department of Defense, Washington, DC (United States). DOE Contract W-7405-ENG-48. Contract N00014-91-F-0114. (CONF-921066–3-Rev.1: Oceans '92, Newport, RI (United States), 26-29 Oct 1992). Order Number DE93011902. Source: OSTI; NTIS; GPO Dep.

A model-based approach is proposed to solve the ocean acoustic signal processing problem that is based on a state-space representation of the normal-mode propagation model. This model is generalized to the stochastic case where an approximate Gauss-Markov model evolves which allows the inclusion of stochastic phenomena such as noise and modeling errors in a consistent manner. Based on this framework, investigations are made of model-based solutions to the signal enhancement, and related parameter estimation problems.

24962 (UCRL-JC–111977-Rev.1) **A zeroth order statistical model for fracture in rock in compression: Revision 1.** Blair, S.C. (Lawrence Livermore National Lab., CA (United States)); Daveler, S.; Cook, N.G.W. Lawrence Livermore National Lab., CA (United States). 23 Mar 1993. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-930644–5-Rev.1: 34. US symposium on rock mechanics, Madison, WI (United States), 27-30 Jun 1993). Order Number DE93011899. Source: OSTI; NTIS; GPO Dep.

Rocks are known to fracture in compression via the formation, extension and coalescence of extensile cracks. These cracks are generally oriented in the direction of the maximum principal stress and as more cracks are formed or existing cracks grow, crack interaction becomes very important. The formation and extension of these cracks under conditions of compression is attributed to local tensions at the microscale that may be caused by heterogeneity in the shape, orientation and strength of grains and other factors [1]. Moreover, fracture mechanics analysis shows that the stress intensity factor for cracks under tensile stress is proportional to the stress difference (σ_1-σ_2) at the site [2]. In addition, it is known that the local stress and strain fields in a rock are dependent on the loading path for the rock. That is, when a crack forms and opens, strain energy is stored in the rock that is not recovered upon unloading [3]. We have developed a model for fracture of rock in compression that incorporates these and other aspects of rock behavior. Our model utilizes afield theory approach to the analysis of microcracking at the grain scale. This approach incorporates the concept of superposition and the techniques of boundary element analysis [4] and percolation theory [5] to form a simple yet powerful method for the study of progressive fracture of rock and other disordered materials. We have simulated triaxial laboratory compression tests using the model and produced strain hardening behavior and patterns of cracking similar to that observed in rocks tested in compression. This technical note describes the detail of the model formulation and presents results for a simulated triaxial test.

24963 (UCRL-JC–111981) **Pore pressure buildup coefficient in synthetic and natural sandstones.** Berge, P.A. (Lawrence Livermore National Lab., CA (United States)); Bonner, B.P.; Wang, H.F. Lawrence Livermore National Lab., CA (United States). Feb 1993. 22p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48 ;FG02-91ER14194. (CONF-930644–9: 34. US symposium on rock mechanics, Madison, WI (United States), 27-30 Jun 1993). Order Number DE93011890. Source: OSTI; NTIS; GPO Dep.

We present laboratory measurements of Skempton's pore pressure buildup coefficient B for synthetic and natural sandstones, and use our results to estimate the unjacketed pore compressibility 1/Kϕ. Measured values of B are always near unity for differential pressures below ~2 MPa, regardless of porosity, grain composition, or the presence of small amounts of clay in the samples. We observed B near 0.7–0.8 for differential pressures of about 8–21

MPa in a clay-free synthetic sandstone. Similar values are expected for natural sandstones with low crack densities, whereas sandstones containing greater concentrations of microcracks apparently have values of B near 0.6. Our results suggest that the pore compressibility may have values close to the pore-fluid compressibility rather than the grain compressibility.

24964 (UCRL-JC–112052) **Inverting ultrasonic data on solid/fluid mixtures for Biot-Gassmann parameters.** Berryman, J.G. (Lawrence Livermore National Lab., CA (United States)); Lumley, D.E. Lawrence Livermore National Lab., CA (United States). Feb 1993. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9306142–1: 2. international conference on mathematical and numerical aspects of wave propagation (SIAM), Newark, DE (United States), 7-10 Jun 1993). Order Number DE93011952. Source: OSTI; NTIS; GPO Dep.

Although the Biot-Gassmann equations axe known to predict acoustic data for water-saturated glass bead packings very well, these equations often seem to give anomalous results for naturally occurring rocks. The theory shows that, as the compressibility of the pore fluid increases, the inverse of the coefficients C and M in Blot's equations should increase linearly, and the theory also gives definite predictions about the values of the slope and intercept of the resulting lines. Although the anticipated linear behavior is observed in real data, the values of the slopes axe smaller than expected for some rocks. Therefore, the process of inverting this data for the desired coefficients must incorporate other physical constraints and then produces, not a single value but rather, a range of possible values for each coefficient.

24965 (UCRL-JC–112366) **AMIP: Diagnostic subproject on the variability in the tropics: Synoptic to intraseasonal time scales.** Sperber, K.R. (Lawrence Livermore National Lab., CA (United States)); Slingo, J.M.; Matthews, A.; Palmer, T.N. Lawrence Livermore National Lab., CA (United States). Dec 1992. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9210334–1: 17. annual climate diagnostics conference, Norman, OK (United States), 19-23 Oct 1992). Order Number DE93009287. Source: OSTI; NTIS; GPO Dep.

The aim of this subproject is to evaluate the ability of GCMs to simulate the transient component of tropical convection and to increase our understanding of the possible processes that govern the development, propagation and dissipation of synoptic disturbances and the intraseasonal oscillation. A pilot study of the tropical variability in a high resolution version of the ECMWF model has already shown that a GCM may have considerable skill in simulating the observed distribution and periodicities of tropical disturbances (Slingo et al. 1993). Verification of the model results will involve satellite data and NWP analyses. In particular, a similar study of the observed intraseasonal oscillation using EC analyses, being carried out as part of the Joint Diagnostics Project at Reading University (Hoskins et al. 1989), will form an important part of the verification of this subproject. In this paper we present a preliminary evaluation of the intraseasonal oscillation as simulated by the ECMWF model. This simulation, with a horizontal resolution of T42 (approximately 2.8°), was performed at Lawrence Livermore National Laboratory on behalf of the European Centre for Medium-Range Weather Forecasts.

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6611 Classical and Quantum Mechanics

Refer also to citation(s) 25001

24966 (DOE/ER/25019–T1) **Nonlinear resonance: Progress report, February 1, 1992–January 31, 1993.** Washington Univ., Seattle, WA (United States). [1993]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG06-86ER25019. Order Number DE93010959. Source: OSTI; NTIS; GPO Dep.

A brief summary of progress is given in the following areas: sustained resonance in non-Hamiltonian systems, two simultaneous sustained resonances, bursting oscillators, and the interaction of a strong shock with weak disturbances. Work will encompass linearly unstable, weakly nonlinear waves.

24967 (JINR-E–2-92-149) **Soliton equations and self-dual gauge fields.** Ivanova, T.A.; Popov, A.D. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of Theoretical Physics. 1992. [12p.] Order Number DE93626620. Source: OSTI; NTIS (US Sales Only); INIS.

The Boussinesq, N-wave, one-dimensional gas dynamics, matrix Korteweg-de Vries and generalized nonlinear Schroedinger equations are shown to be reductions of the self-duality equations for gauge fields. 28 refs.

24968 (JINR-E–2-92-322) **Radiation perturbation theory in gravity and quantum universe as a hydrogen atom.** Pervushin, V.N. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of Theoretical Physics. 1992. [7p.] Order Number DE93626621. Source: OSTI; NTIS (US Sales Only); INIS.

In quantum theory of gravity of the (n+1)-dimensional space-time the Faddeev-Popov functional integral is constructed for radiation perturbation theory. In this version the Universe expansion looks as the collective superfluid motion of quantum space, and the vacuum energy density plays the role of the hidden mass. 6 refs.

24969 (JINR-E–5-92-75) **Spherical anharmonic oscillator in self-similar approximation.** Yukalova, E.P.; Yukalov, V.I. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of Theoretical Physics. 1992. [16p.] Order Number DE93626622. Source: OSTI; NTIS (US Sales Only); INIS.

The method of self-similar approximation is applied here for calculating the eigenvalues of the three-dimensional spherical anharmonic oscillator. The advantage of this method is in its simplicity and high accuracy. The comparison with other known analytical methods proves that this method is more simple and accurate. 25 refs.

24970 (JINR-R–2-92-47) **A hydrogen atom in the curved space: orthogonality of radial wave functions with respect to the critical momentum.** Mardoyan, L.G. (Erevanskij Gosudarstvennyj Univ., Erevan (Armenia)); Sisakyan, A.N. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of Theoretical Physics. 1992. [6p.] (In Russian). Order Number DE93626623. Source: OSTI; NTIS (US Sales Only); INIS.

The condition of orthogonality in the orbital momentum of radial wave functions of a hydrogen atom in the curved space of constant positive curvature. This condition of orthogonality is proved to be consequence of accidental degeneration of the energy spectrum. 8 refs.

24971 (JINR-R–2-92-48) **Clusterization of quantum states in the Hartmann model.** Lutsenko, I.V.; Magakyan, A.D.; Sisakyan, A.N.; Ter-Antonyan, V.M. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of Theoretical Physics. 1992. [6p.] (In Russian). Order Number DE93626624. Source: OSTI; NTIS (US Sales Only); INIS.

The effect of clusterization of quantum, states in the Hartmann is predicted and explained. 12 refs.; 5 figs.

24972 (JINR-R–4-92-32) **Exactly solvable three-body with two-center potentials.** Suz'ko, A.A. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of Theoretical Physics. 1992. [26p.] (In Russian). Order Number DE93626625. Source: OSTI; NTIS (US Sales Only); INIS.

Exactly solvable models of the three-particle scattering problem in the adiabatic approach are developed on the basis of algebraic generalized Bargmann - Darboux trandformations. Supersymmetric treatment of gauge adiabatic models in the three-body problem. Analytic solutions are constructed for a slow subsystem of equations. 22 refs.

24973 (UCRL-JC–110006) **RCS modeling with the TSAR FDTD code.** Pennock, S.T.; Ray, S.L. Lawrence Livermore National Lab., CA (United States). Mar 1992. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-920750–7: Institute of Electrical and Electronic

Engineers Antennas and Propagation Society (IEEE-APS) international symposium, Chicago, IL (United States), 18-25 Jul 1992. Order Number DE93012481. Source: OSTI; NTIS; GPO Dep.

The TSAR electromagnetic modeling system consists of a family of related codes that have been designed to work together to provide users with a practical way to set up, run, and interpret the results from complex 3-D finite-difference time-domain (FDTD) electromagnetic simulations. The software has been in development at the Lawrence Livermore National Laboratory (LLNL) and at other sites since 1987. Active internal use of the codes began in 1988 with limited external distribution and use beginning in 1991. TSAR was originally developed to analyze high-power microwave and EMP coupling problems. However, the general-purpose nature of the tools has enabled us to use the codes to solve a broader class of electromagnetic applications and has motivated the addition of new features. In particular a family of near-to-far field transformation routines have been added to the codes, enabling TSAR to be used for radar-cross section and antenna analysis problems.

6612 Techniques of General Use In Physics

Refer also to citation(s) 23171, 23173, 24402, 25057, 25059, 25115

24974 (CONF-9207203–, pp. 66) **Beam of electrons for emission control.** Maezawa, A. (Ebara Corp., Tokyo (Japan)). 22 Jul 1992. 320p. (In Japanese). From 1. meeting of The Japan Institute of Energy and the 70th Foundation anniversary meeting; Tokyo (Japan); 22-24 Jul 1992. In *Proceedings of the 1st Meeting of the Japan Institute of Energy and the 70th Foundation Anniversary Meeting.* Order Number DE93793523. Source: OSTI; NTIS (US Sales Only).

The keynote speech was introduced about the emission control system by beam of electrons. That system is a dry type simultaneous desulfurization/denitrification system which was developed cooperatively with the Japan Atomic Energy Research Institute. Because of dry type, that system does not produce exhaust water and consequently, it does not need large scale exhaust water treatment facilities. The desulfurization/denitrification ratio by that system is higher than that by the conventional system. The system structure is simple as the desulfurization and denitrification proceed both simultaneously. The existing exhaust gas production source is easily connectable as the reaction temperature is not required to be high. Waste is not produced as the by-products (ammonium sulfate and its mixture) can be recycled as fertilizer. That system is applicable into a range where both SOx and NOx concentrations extend from several ppM to several thousands of ppM Explanation was also made of actual examples and results of applying that system to exhaust gas from the iron ore sintering furnace, exhaust gas by the coal combustion and exhaust dilute gas from the diesel.

24975 (DOE/FTR–93013411) **[Travel to Kiev, Ukraine to present a paper describing work done at Fermilab on the development of advanced cryogenic insulation systems at the International Cryogenic Engineering Conference (ICEC-14)]: Foreign trip report, June 5–13, 1992.** Boroski, W.N. Fermi National Accelerator Lab., Batavia, IL (United States). 16 Jul 1992. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03000. Order Number DE93013411. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The paper was well received at the conference; particularly interested were CERN researchers who were making similar measurements on cryogenic insulations for the proposed Large Hadron Collider project. Notes are presented on the attendees, most of whom were Russians, Ukrainians, and Europeans. Papers were presented across the entire spectrum of cryogenics: heat and fluid transfer, high temperature superconductors, and cryocoolers, large cryogenic systems, etc. The Ukrainian Academy of Sciences is doing a great deal of work in cryogenics. Some personal conversations about Chernobyl are reported briefly.

24976 (INDC(NDS)–213/GM3, pp. 47) **Appendix 1.** Soloviev, S. (Radievyj Inst., Leningrad (Russian Federation)). International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Oct 1988. (CONF-8809159–: 14. world conference of the International Nuclear Target Development Society (INTDS): heavy-ion targets and related phenomena, Darmstadt (Germany), 5-9 Sep 1988). In *The influence of target and sample properties on nuclear data measurements: Summary report of the IAEA advisory group meeting in co-operation with the International Nuclear Target Development Society (INTDS), held in Darmstadt, Germany, 5-9 September 1988.* [74p.] Order Number DE93626092. Source: OSTI; NTIS (US Sales Only); INIS.

In the Khlopin Radium Institute targets containing fissile nuclides from U up to Cf are prepared, including those: with active layer areal density up to 10 mg/cm^2 (U), 3 mg/cm^2 (Th), 1 mg/cm^2 (Np, Pu); on the backings support from Al_2O_3; with low number of nuclei (up to 10^{13}); with inhomogeneity of active layer of about ≈1%. The following semiconductor detectors with non-planar shape are produced: $2\pi\alpha$ (for calibration purposes low activity target with a diameter up to 24mm); Cylindrical (outer diameter 5mm); Canal (diameter of canal 5-8 mm). Semiconductor detectors with fissile layer on the sensitive surface: The conditions of target and detector production should be agreed with the Institute management. (author). Abstract only.

24977 (INDC(NDS)–213/GM3, pp. 51) **Appendix 5.** Heagney, J.M. (MICROMATTER Co., Deer Harbor, WA (United States)). International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Oct 1988. (CONF-8809159–: 14. world conference of the International Nuclear Target Development Society (INTDS): heavy-ion targets and related phenomena, Darmstadt (Germany), 5-9 Sep 1988). In *The influence of target and sample properties on nuclear data measurements: Summary report of the IAEA advisory group meeting in co-operation with the International Nuclear Target Development Society (INTDS), held in Darmstadt, Germany, 5-9 September 1988.* [74p.] Order Number DE93626092. Source: OSTI; NTIS (US Sales Only); INIS.

MICROMATTER offers the experimenter a wide range of foil and target fabrication capabilities. Our capabilities include pressing, rolling, and vacuum evaporation of both natural and isotopically enriched materials. We also perform some reductions of isotopic materials used in these samples. We prefer to mount foils on customer provided frames and ship ready for use in our returnable vacuum shipping container, except for thicker gauge foils which may be shipped self-supporting. (For detailed information request our Foil Products and Accelerator Target Service Information.) We also offer carbon foils on glass slides in the thickness range from 3 to 50 μgm/cm^2. (Request Carbon Foil Information.) For X-ray fluorescence we offer 63 elements as thin, single-element calibration standards on a wide variety of backing and mounts. (Request X-ray Fluorescence Standards Information.). (author). Abstract only.

24978 (INDC(NDS)–213/GM3, pp. 70) **Problems of tritium targets.** Seeliger, D. (Technische Univ. Dresden (Germany)). International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Oct 1988. (CONF-8809159–: 14. world conference of the International Nuclear Target Development Society (INTDS): heavy-ion targets and related phenomena, Darmstadt (Germany), 5-9 Sep 1988). In *The influence of target and sample properties on nuclear data measurements: Summary report of the IAEA advisory group meeting in co-operation with the International Nuclear Target Development Society (INTDS), held in Darmstadt, Germany, 5-9 September 1988.* [74p.] Order Number DE93626092. Source: OSTI; NTIS (US Sales Only); INIS.

Solid state tritium targets are widely used for 14 MeV neutron production of DT-neutron generators. Usually they are produced by evaporation of a titanium and zirconium layer on a thin copper backing, with a subsequent absorption of tritium gas in it. The literature of solid state tritium targets during irradiation with ion beam is limited by the heating of the target connected with a higher diffusion rate of tritium out of the titanium layer, the formation of thin carbon layers at the surface and also ion sputtering processes. It depends also on the composition of ion beam striking the targets (admixture of molecular a.o. components). The use of tritium targets implies the necessity of radiation protection measures due to the radioactivity of tritium. The present status of this aspect is discussed in the paper presented including some recommendations concerning the most efficient use of solid state tritium targets. (author). Abstract only.

24979 (INDC(NDS)–213/GM3, pp. 70-71) **Tritium solid targets for intense D-T neutron production and its related problems.** Sumita, Kenji (Osaka Univ., Suita (Japan). Faculty of Engineering). International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Oct 1988. (CONF-8809159–: 14. world conference of the International Nuclear Target Development Society (INTDS): heavy-ion targets and related phenomena, Darmstadt (Germany), 5-9 Sep 1988). In *The influence of target and sample properties on nuclear data measurements: Summary report of the IAEA advisory group meeting in co-operation with the International Nuclear Target Development Society (INTDS), held in Darmstadt, Germany, 5-9 September 1988.* [74p.] Order Number DE93626092. Source: OSTI; NTIS (US Sales Only); INIS.

This review paper is divided into three parts. Firstly, to attain an intense neutron production rate, the construction of a design with a higher tritium-containing surface and an effective cooling system like a rotating target device are discussed. The maximum attainable intensity based on tritium solid targets shall be estimated regarding planning for future D-T sources. Secondly, on the way to carry out some experiments, an absolute intensity calibration and an angular dependent neutron energy spectrum of the neutron source are essential parameters to analyse the results of the experiments. Sometimes the space dependent neutron spectrum is required as well as the space dependent neutron flux near the targets and irradiation samples. The measurement methods and their examples are reviewed for tritium solid targets. The third part is devoted to discuss the protection to tritium contamination problems due to unavoidable release of tritium gas from targets. Performance and effectiveness of tritium collection systems for intense D-T neutron sources shall be discussed in some examples. Tritium contamination incidents due to the faulted film powder of target surface are also reported in some real incident cases. (author). Abstract only.

24980 (INDC(NDS)–213/GM3, pp. 73) **Use of Rutherford Backscattering to determine uranium deposit uniformity.** Wasson, O.A. (National Inst. of Standards and Technology, Gaithersburg, MD (United States)); Schrack, R.A. International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Oct 1988. (CONF-8809159–: 14. world conference of the International Nuclear Target Development Society (INTDS): heavy-ion targets and related phenomena, Darmstadt (Germany), 5-9 Sep 1988). In *The influence of target and sample properties on nuclear data measurements: Summary report of the IAEA advisory group meeting in co-operation with the International Nuclear Target Development Society (INTDS), held in Darmstadt, Germany, 5-9 September 1988.* [74p.] Order Number DE93626092. Source: OSTI; NTIS (US Sales Only); INIS.

A Rutherford Backscattering (RBS) facility has been established at the 3-MV positive-ion accelerator at the National Bureau of Standards. This facility has been used to study the areal density distribution of uranium deposits used in neutron cross section measurements. A versatile scattering chamber with numerous ports, five-axis goniometer, target ladder, and solid state detector is in operation. Beams of 1 MeV He^+ ions and 5 MeV He^{++} ions are available. The variation in areal density of a 75 cm diameter UO_2 deposit was measured using a 1 MeV He^+ beam. The results are in excellent agreement with those obtained from alpha-particle activity measurements. However, the RBS measurements provide better definition of the uniformity near the edge of the deposits. Our experience in the use of these two methods to characterize the areal densities of deposits for cross section measurements will be presented. (author). Abstract only.

24981 (IS-M–746) **Gas atomized Er_3Ni powder for cryocooler applications.** Anderson, I.E.; Osborne, M.G.; Takeya, H.; Gschneidner, K.A. Jr. Ames Lab., IA (United States). [1992]. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-82. (CONF-921130–2: 7. international cryocooler conference, Santa Fe, NM (United States), 15-19 Nov 1992). Order Number DE93011564. Source: OSTI; NTIS; INIS; GPO Dep.

A high pressure gas atomization (HPGA) approach was developed to produce uniform spherical powders of high purity Er_3Ni and 3 batches of about 1.3 kg each were prepared. Average yield of high qualityspherical powders between 0.15 and 0.35mm was about 16% of the initial atomizer charge weight. Microstructural analysis of sectioned powder samples revealed single phase particles with some internal cracking but no evidence of an oxidized surface shell. Chemical analysis and x-ray diffraction measurements verified that single phase particles of the stoichiometric composition had been generated. Vacuum fusion measurements indicated that the powder contained 2600ppM oxygen. The heat capacity of a hot pressed, partially sintered Er_3Ni powder sample was measured from 2 to 80K; results indicated a maximum heat capacity of0.43 J/cm^3K at 7K and the peak appears to be about 0.04 J/cm^3K higher and narrower than reported by Sahashi. The Sahashi heat capacity peak has two maxima, suggesting the two phases in their material. Our Er_3Ni powder has a larger heat capacity than Pb over the entire range of temperatures up to about 25K which should permit a lower final temperature for a cryocooler stage composed of this material

24982 (LA-UR–93-1420) **The superfluid Stirling refrigerator, a new method for cooling below 0.5 K.** Brisson, J.G.; Kotsubo, V.; Swift, G.W. Los Alamos National Lab., NM (United States). 9 Apr 1993. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930801–1: Conference of the International Union of Pure and Applied Physics on low temperature physics (LT 20), Eugene, OR (United States), 1-11 Aug 1993). Order Number DE93012672. Source: OSTI; NTIS; INIS; GPO Dep.

A new subkelvin refrigerator, the superfluid Stirling cycle refrigerator, uses a working fluid of ^3He-^4He mixture in a Stirling cycle. The thermodynamically active components of the mixture are the ^3He, which behaves like a Boltzman gas, and the phonon-roton gas in the ^4He. The superfluid component of the liquid is inert. Two refrigerators have been built and temperatures of 340 mK have been achieved.

24983 (SAND–92-2221C) **Compound-lens injector for a 19-MeV, 700-kA electron beam.** Sanford, T.W.L. (Sandia National Labs., Albuquerque, NM (United States)); Poukey, J.W.; Halbleib, J.A.; Mock, R.C. Sandia National Labs., Albuquerque, NM (United States). [1992]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-930511–3: International particle accelerator conference, Washington, DC (United States), 17-20 May 1993). Order Number DE93013752. Source: OSTI; NTIS; INIS; GPO Dep.

A robust injector capable of controlling the radius and angle of incidence of the intense, pulsed, annular electron beam extracted from the HERMES-III accelerator is described. The injector, called the compound lens, uses a tapered anode to control the beam electrostatically, followed by a gas cell with externally applied current to control the beam magnetically. Adjustment of the anode-cathode gap and external current of the injector permits the mean radius and injection angle of the beam to be defined independently of one another. Measurements of these quantities confirm model expectations. The extended planar-anode diode with a thin anode window has been used to inject a 25-ns, 19-MeV, 700-kA, annular electron beam into gas-filled drift cells for beam transport to bremsstrahlung targets located downstream of the HERMES-III accelerator. By adjusting the anode-cathode (AK) gap of the diode, the radius and angle of incidence of the annular beam at injection can be varied. Here the authors theoretically model and experimentally characterize the electron flow in the compound-lens diode when it is used as a bremsstrahlung source. Results are presented as the AK gap is increased to 40 cm. The model combines the MAGIC code to simulate the time-dependent electron flow in the AK gap and lens with the CYLTRAN code of the ITS system to model window effects and the subsequent transport in the target.

6613 Other Aspects of Physical Science

Refer also to citation(s) 24137, 24263, 24428, 24471, 24513, 24964, 25070, 25101, 25196, 25205, 25434

24984 (DOE/ER/13530–5) **[A study of the magnetic field annihilation process in the magnetosphere and some geotechnical applications]: Progress report.** Alaska Univ., Fairbanks, AK (United States). Geophysical Inst. [1993]. 8p. Sponsored by

USDOE, Washington, DC (United States). DOE Contract FG06-86ER13530. (GI–91-75). Order Number DE93013249. Source: OSTI; NTIS; GPO Dep.

This paper describes significant progress made in the study of magnetic field reconnection and plasma processes in the magnetosphere in the past three years. A total of 43 research and review papers have been completed under the DOE support. In this paper, some of the most important results obtained in the past three-years are described.

24985 (DOE/ER/13726–6) **Fundamentals and techniques of nonimaging optics.** Winston, R. Chicago Univ., IL (United States). Enrico Fermi Inst. Apr 1993. 53p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-87ER13726. Order Number DE93013145. Source: OSTI; NTIS; GPO Dep.

For many tasks in illumination and collection the acceptance angle is required to vary along the reflector. If the acceptance angle function is known, then the reflector profile can be calculated as a functional of it. The total flux seen by an observer from a source and its brightness (radiance) is proportional to the sum of the view factor of the source and its reflection. This allows one to calculate the acceptance angle function necessary to produce a certain flux distribution and thereby construct the reflector profile. We demonstrate the method for several examples, including finite size sources with reflectors directly joining the source.

24986 (DOE/ER/13740–10) **[Investigation of transitions from order to chaos in dynamical systems].** Stevens Inst. of Tech., Hoboken, NJ (United States). [1992]. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-87ER13740. Order Number DE93014437. Source: OSTI; NTIS; INIS; GPO Dep.

This report briefly discusses the following topics on chaotic systems; numerical investigations of fast dynamo problem for stationary space-periodic flows with chaotic streamlines; analytical and numerical investigations of magnetic field generation by conducting flows with finite resistivity; and emittance growth in charged particle beams.

24987 (DOE/FTR–93012817) **Travel to Institut d'Astronomie et d'Astrophysique to teach and to pursue research in various problems in nuclear astrophysics: Foreign trip report, 1 January–1 September 1992.** Howard, W.M. Lawrence Livermore National Lab., CA (United States). 1 Oct 1992. 34p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE93012817. Source: OSTI; NTIS (US Sales Only); GPO Dep.

During the period 1 January, 1992 to 1 September, 1992, I was on Professional Research and Teaching Leave (PRTL) at the Insitut d'Astronomie et d'Astrophysique at the Universite Libre de Bruxelles, Brussels, Belgium. The purpose of the PRTL was to pursue research in various problems in nuclear astrophysics in collaboration with my European colleagues. As part of my PRTL I visited several research institutes and attended several meetings. These included visits to the University of Mainz, the Institute fur Kernphysik, Kernforschungszentrum, in Karlsruhe, Germany, the Max Planck Institute for Astrophysics in Garching Germany and the Torino Observatory in Torino, Italy. I also attended the meeting Nuclei in the Cosmos II in Karlsruhe, Germany and the 55th Annual Meteoritical Society Meeting in Copenhagen, Denmark. My research at the Insitut d'Astronomie et d'Astrophysique concentrated on several areas, including: (1) the anomalous heavy element compositions of SiC grains, (2) the p-process nucleosynthesis in Type Ia supernovae, (3) astudy of the neutron-rich α-rich freeze out and subsequent r-process that is thought to occur in Type II supernovae and (4) the influence of opacities on the helium shell instabilities in AGB stars. The work on the SiC grain compositions resulted in contributions to two conferences and a paper submitted to Meteoritics. The work on the astrophysical p-process resulted in a contribution to Nuclei in the Cosmos IIin Karhsruhe, as did the work on the astrophysical r-process. Continuation of all of this research is planned for the future. Below is a very brief summary of this work.

24988 (FNAL/C–92/313-A) **Inflation after COBE: Lectures on inflationary cosmology.** Turner, M.S. (Chicago Univ., IL (United States). Enrico Fermi Inst.). Fermi National Accelerator Lab., Batavia, IL (United States). [1992]. 70p. Sponsored by USDOE, Washington, DC (United States); National Aeronautics and Space Administration, Washington, DC (United States). DOE Contract AC02-76CH03000. Grant: NAGW-2381. (CONF-9206314–2: TASI summer school; Cargese summer school on quantitative particle physics; Varenna summer school on galaxy formation, Boulder, CO (United States); Corsica (France); Varenna (Italy), 11-29 Jun 1992; jul 1992; jul 1992; CONF-9207199–1; C Order Number DE93014008. Source: OSTI; NTIS; INIS; GPO Dep.

In these lectures I review the standard hot big-bang cosmology, emphasizing its successes, its shortcomings, and its major challenge-a detailed understanding of the formation of structure in the Universe. I then discuss the motivations for and the fundamentals of inflationary cosmology, particularly emphasizing the quantum origin of metric (density and gravity-wave) perturbations. Inflation addresses the shortcomings of the standard cosmology and provides the "initial data" for structure formation. I conclude by addressing the implications of inflation for structure formation, evaluating the various cold dark matter models in the light of the recent detection of temperature anisotropies in the cosmic background radiation by COBE. In the near term, the study of structure formation offers a powerful probe of inflation, as well as specific inflationary models.

24989 (FNAL/Pub–93/057-A) **Sterile neutrinos as dark matter.** Dodelson, S. (Fermi National Accelerator Lab., Batavia, IL (United States)); Widrow, L.M. Fermi National Accelerator Lab., Batavia, IL (United States); Toronto Univ., ON (Canada). Canadian Inst. for Theoretical Astrophysics. Mar 1993. 11p. Sponsored by USDOE, Washington, DC (United States); National Aeronautics and Space Administration, Washington, DC (United States). DOE Contract AC02-76CH03000. Grant NAGW-2381. Order Number DE93012533. Source: OSTI; NTIS; INIS; GPO Dep.

The simplest model that can accommodate a viable nonbaryonic dark matter candidate is the standard electroweak theory with the addition of right-handed or sterile neutrinos. This model has been studied extensively in the context of the hot dark matter scenario. We reexamine this model and find that hot, warm, and cold dark matter are all possibilities. We focus on the case where sterile neutrinos are the dark matter. Since their only direct coupling is to left-handed or active neutrinos, the most efficient production mechanism is via neutrino oscillations. If the production rate is always less than the expansion rate, then these neutrinos will never be in thermal equilibrium. However, they may still play a significant role in the dynamics of the Universe and possibly provide the missing mass necessary for closure. We consider a single generation of neutrino fields (ν_L, ν_R) with a Dirac mass, μ, and a Majorana mass for the right-handed components only, M. For $M \gg \mu$ we show that the number density of sterile neutrinos is proportional to μ^2/M so that the energy density today is independent of M. However M is crucial in determining the large scale structure of the Universe. In particular, $M \simeq 0.1$–1.0 key leads to warm dark matter and a structure formation scenario that may have some advantages over both the standard hot and cold dark matter scenarios.

24990 (JINR-D–2-91-499) **The electric field of a current-carrying conductor.** Strel'tsov, V.N. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of High Energy. 1991. [4p.] Order Number DE93626637. Source: OSTI; NTIS (US Sales Only); INIS.

A subject concerning the relativistic invariance of the Gauss theorem has been discussed. The appearance of the electric field around the neutral conductor after excitation of current in it doesn't signify the change of its charge. 8 refs.; 1 fig.

24991 (JINR-E–2-92-39) **On the electrical toroidal solenoids.** Afanas'ev, G.N. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of Theoretical Physics. 1992. [8p.] Order Number DE93626639. Source: OSTI; NTIS (US Sales Only); INIS.

Submitted to Phys. Lett., A.

We give explicit construction of electrical toroidal solenoid and discuss its properties. 16 refs.; 3 figs.

24992 (JINR-E–11-92-236) **Iteration scheme for the multiparameter nonlinear boundary value problem with the additional**

conditions and its application to some field models. Amirkhanov, I.V.; Puzynin, I.V.; Strizh, T.A. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of Computing Techniques and Automation. 1992. [14p.] Order Number DE93626638. Source: OSTI; NTIS (US Sales Only); INIS.

Submitted to the International Workshop 'Polarons and Applications', May 25-31, 1992, Pushchino, Russia.

The iterative scheme based on the combination of Continuous analogue of the Newton's method and Continuation method was developed for the solving a boundary value problem together with an additional condition. The accuracy was investigated numerically. The suggested method was applied for the numerical investigation of the equations of the solvated electron problem, of some bielectron problem and one QCD problem with an increasing potential. 10 refs.; 6 figs.; 2 tabs.

24993 (KFKI–1992-22/B) **Remarks on the Robinson-Trautman solutions.** Hoenselaers, C. (Loughborough Univ. of Technology (United Kingdom). Dept. of Mathematics); Perjes, Z. Hungarian Academy of Sciences, Budapest (Hungary). Central Research Inst. for Physics. Aug 1992. [14p.] Order Number DE93626640. Source: OSTI; NTIS (US Sales Only); INIS.

Robinson-Trautman space-times with a spacelike Killing vector are considered. It is shown that there are special initial values for which the solution does not exist for all future times. In general, however, the solution will asymptotically go over into the C-metric. Perturbations of the C-metric are discussed. The results of numerical calculations are shown. (author) 13 refs.; 5 figs.

24994 (LA-UR–93-1241) **Imaging of magnetospheric dynamics using low energy neutral atom detection.** Funsten, H.O.; McComas, D.J.; Moore, K.R.; Scime, E.E. Los Alamos National Lab., NM (United States). [1993]. 19p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9302115–1: AGU monograph/solar system plasma physics meeting on resolution of processes in space and time, Yosemite, CA (United States), Feb 1993). Order Number DE93012656. Source: OSTI; NTIS; GPO Dep.

Recent advances in low energy neutral atom (LENA) detection technology show that magnetospheric imaging is achievable with $4_o \times 4_o$ resolution and can distinguish numerous features of the magnetosphere. A critical factor in detecting low energy neutrals is their removal from the ambient UV background. One technique to accomplish this is by ionizing the neutrals by their transmission through an untrathin charge modification foil and subsequent electrostatic deflection. In this type of instrument, the driving factor for resolution and sensitivity is scattering in the foil and the ionization probability of transiting neutrals. We describe results of a prototype LENA imager using a collimated beam of 10 key H. Additionally, we illustrate model results of anticipated LENA images of the magnetosphere based on the Rice Convection Model and show that plasma variations resulting from geomagnetic storm disturbances can be observed using a LENA imager.

24995 (LA-UR–93-1286) **Solar wind channels for MeV particles.** Page, D.E. (Jet Propulsion Lab., Pasadena, CA (United States)); Goldstein, B.G.; Bame, S.J. Los Alamos National Lab., NM (United States). [1993]. 5p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930779–8: International cosmic-ray conference, Calgary (Canada), 19-20 Jul 1993). Order Number DE93012648. Source: OSTI; NTIS; GPO Dep.

Plasma, magnetic field and charged particle data from the Ulysses spacecraft is used to demonstrate that MeV particles follow channels defined by solar wind flow regimes.

24996 (LA-UR–93-1470) **Ion anisotropy driven waves in the earth's magnetosheath and plasma depletion layer.** Denton, R.E. (Dartmouth Coll., Hanover, NH (United States). Dept. of Physics and Astronomy); Hudson, M.K.; Anderson, B.J.; Fuselier, S.A.; Gary, S.P. Los Alamos National Lab., NM (United States). [1993]. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9302115–3: AGU monograph/solar system plasma physics meeting on resolution of processes in space and time, Yosemite, CA (United States), Feb 1993). Order Number DE93012751. Source: OSTI; NTIS; GPO Dep.

Recent studies of low frequency waves ($\omega_r \leq \Omega_p$, where Ω_p is the proton gyrofrequency) observed by AMPTE/CCE in the plasma depletion layer and magnetosheath proper arereviewed. These waves are shown to be well identified with ion cyclotron and mirror mode waves. By statistically analyzing the transitions between the magnetopause and time intervals with ion cyclotron and mirror mode waves, it is established that the regions in which ion cyclotron waves occur are between the magnetopause and the regions where the mirror mode is observed. This result is shown to follow from the fact that the wave spectral properties are ordered with respect to the proton parallel beta, $\beta_{||p}$. The later result is predicted by linear Vlasov theory using a simple model for the magnetosheath and plasma depletion layer. Thus, the observed spectral type can be associated with relative distance from the magnetopause. The anisotropy-beta relation, $A_p \equiv (T\perp/T_{||})_p - 1 = 0.50\beta_{||p}{}^{-0.48}$ results from the fact that the waves pitch angle scatter the particles so that the plasma is near marginal stability, and is a fundamental constraint on the plasma.

24997 (LA-UR–93-1605) **Search for UHE emission from Cygnus X-3.** Stark, M.J. The CYGNUS Collaboration. Los Alamos National Lab., NM (United States). [1993]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930779–5: International cosmic-ray conference, Calgary (Canada), 19-20 Jul 1993). Order Number DE93012720. Source: OSTI; NTIS; INIS; GPO Dep.

Data from the CYGNUS experiment has been searched for evidence of ultra high energy (UHE) emission from Cygnus X-3. An upper limit to continuous flux from the source is given. In addition, we find no evidence for episodic emission from Cygnus X-3 on any time scale from 3.3 minutes to 4 years. The results of searches for periodic emission from Cygnus X-3 will be presented at the conference.

24998 (LA-UR–93-1608) **Search for ultra-high energy emission from Geminga and five unidentified EGRET sources.** The CYGNUS Collaboration. Los Alamos National Lab., NM (United States). [1993]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930779–6: International cosmic-ray conference, Calgary (Canada), 19-20 Jul 1993). Order Number DE93012717. Source: OSTI; NTIS; GPO Dep.

Data from the CYGNUS extensive air shower array were searched for continuous ultra-high energy (UHE) gamma radiation from five unidentified EGRET sources and from the Geminga pulsar. No evidence for continuous emission from any of these objects was found. Data in the Geminga source bin were also searched for pulsed emission using the recent EGRET ephemeris (237 ms period). No evidence of a periodic signal was found. The 90% confidence level upper limit on the continuous gamma-ray flux above 80 TeV for Geminga is 7.9×10^{-14} cm^{-2} s^{-1}.

24999 (LA-UR–93-1609) **A new limit on the rate-density of evaporating black holes.** The CYGNUS Collaboration. Los Alamos National Lab., NM (United States). [1993]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930779–9: International cosmic-ray conference, Calgary (Canada), 19-20 Jul 1993). Order Number DE93012716. Source: OSTI; NTIS; INIS; GPO Dep.

Data taken with the CYGNUS detector between 1989 and 1993 have been used to search for 1 second bursts of ultra-high energy (UHE) gamma rays from any point in the northern sky. There is no evidence for such bursts. Therefore the theory-dependent upper limit on the rate-density of evaporating black holes is $6.1 \times 10^5 \mathrm{pc}^{-3}\mathrm{yr}^{-1}$ at the 99% C.L.. After renormalizing previous direct searches to the same theory, this limit is the most restrictive by more than 2 orders of magnitude.

25000 (LBL–33995) **Capillary surfaces in a wedge: Differing contact angles.** Concus, P. (Lawrence Berkeley Lab., CA (United States)); Finn, R. Lawrence Berkeley Lab., CA (United States). Apr 1993. 12p. Sponsored by USDOE, Washington, DC (United States); National Aeronautics and Space Administration,

Washington, DC (United States); National Science Foundation, Washington, DC (United States). DOE Contract AC03-76SF00098. Grant: NAG3-1143;Grant: DMS89-02831. (CONF-9305197–1: International symposium on microgravity science and application, Beijing (China), 10-13 May 1993). Order Number DE93013903. Source: OSTI; NTIS; GPO Dep.

The possible zero-gravity equilibrium configurations of capillary surfaces u(x,y) in cylindrical containers whose sections are (wedge) domains with corners are investigated mathematically, for the case in which the contact angles on the two sides of the wedge may differ. In such a situation the behavior can depart in significant qualitative ways from that for which the contact angles on the two sides are the same. Conditions are described under which such qualitative changes must occur. Numerically computed surfaces are depicted to indicate the behavior.

25001 (SLAC-PUB–6057) **Quantized conic sections; quantum gravity.** Noyes, H.P. Stanford Linear Accelerator Center, Menlo Park, CA (United States). 15 Mar 1993. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00515. (CONF-9302102–1: ANPA WEST 9 conference, Stanford, CA (United States), 13-15 Feb 1993). Order Number DE93010950. Source: OSTI; NTIS; INIS; GPO Dep.

Starting from free relativistic particles whose position and velocity can only be measured to a precision $< \Delta r \Delta v > \equiv \pm$ k/2 meter^{2}sec^{-1} , we use the relativistic conservation laws to define the relative motion of the coordinate $r = r_1 - r_2$ of two particles of mass m_1, m_2 and relative velocity $v = \beta c = {}_{(k_1+k_2)}/{}^{(k_1-k_2)}$ in terms of conic section equation $v^2 = \Gamma\,[2/r \pm 1/a]$ where "+" corresponds to hyperbolic and "−" to elliptical trajectories. Equation is quantized by expressing Kepler's Second Law as conservation of angular niomentum per unit mass in units of k. Principal quantum number is $n \equiv j + \frac{1}{2}$ with"square" ${}_{T^2}/{}^{A^2} = (n-1)nk^2 \equiv \ell_\odot(\ell_\odot + 1)k^2$. Here $\ell_\odot = n - 1$ is the angular momentumquantum number for circular orbits. In a sense, we obtain "spin" from this quantization. Since Γ/ a cannot reach c^2 without predicting either circular or asymptotic velocities equal to the limiting velocity for particulate motion, we can also quantize velocities in terms of the principle quantum number by defining $\beta_n{}^{/2} = {}_{c^2}/{}^{n^2} = {}_{n^2}/1({}_{c^2}\ a/\Gamma\ ) = ({}_{n\Gamma}/1)^2$. For the Z_1 e,Z_2 e of the same sign and $\alpha \equiv e^2/m_e \kappa$ c, we find that $\Gamma/\ c^2\ a = Z_1\ Z_2\alpha$. The characteristic Coulomb parameter $\eta\ (n) \equiv Z_1\ Z_2\alpha/\beta_n = Z_1 Z_2\ nN_\Gamma$ then specifies the penetration factor $C^2(\eta) = 2\pi\eta\ /\ (e^{2\pi\eta} - 1)$. For unlike charges, with η still taken as positive, $C^2(-\eta) = 2\pi\eta/(1 - e^{-2\pi\eta})$.

25002 (UCRL-CR–110994) **Localized wave solutions in optical fiber waveguides.** Besieris, I.M. (Virginia Polytechnic Inst. and State Univ., Blacksburg, VA (United States). Dept. of Electrical Engineering); Vengsarkar, A.M. Lawrence Livermore National Lab., CA (United States); Virginia Polytechnic Inst. and State Univ., Blacksburg, VA (United States). Dept. of Electrical Engineering. Aug 1991. 126p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE93009214. Source: OSTI; NTIS; GPO Dep.

A novel bidirectional decomposition of exact solutions to the scalar wave equation has been shown to form a natural basis for synthesizing localized wave (LW) solutions that describe localized, slowly decaying transmission of energy in free space. In this work, we demonstrate the existence of LW solutions in optical fiber waveguides operated in the linear regime. In this sense, these solutions are fundamentally different from the non-linear, soliton-based communication systems. Despite the dielectric waveguiding constraints introduced by the fiber, solutions that resemble the fire-space solutions can be obtained with broad bandwidth source spectra As with the fire-space case, these optical waveguide LW solutions propagate over very long distances, undergoing only local variations. Four different source modulation spectra that give rise to solutions similar to Focus Wave Modes (FWM's), splash pulses, the scalar equivalent of Hilhon's spinor modes and the Modified Power Spectrum (MPS) pulses are considered. A detailed study of the MPS pulse is performed, practical issues regarding source spectra are addressed, and distances over which such LW solutions maintain their non-decaying nature are quantified. Present day state-of-the-art technology is not capable of meeting requirements that will make practical implementation of LW solution-based fiber optic systems a reality. We address futuristic technology issues and briefly describe efforts that could lead to efficient LW solution-based fiber optic systems.

25003 (UCRL-ID–113019) **The accuracy of approximating radiative heat transfer using a temperature dependent thermal conductivity.** Creighton, J.R. Lawrence Livermore National Lab., CA (United States). 11 Feb 1993. 25p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE93013105. Source: OSTI; NTIS; GPO Dep.

Radiative heat transfer across the gap between two coaxial cylinders can be approximated using an equivalent thermal conductivity that is a cubic polynomial in the temperatures T_1 and T_2 of the two surfaces ($T_1 > T_2$). It is convenient to write the polynomial in terms of the average temperature, yielding $T_{avg}{}^3$ multiplied by an expression in T_{avg}/T_1. This expression has a value close to unity when the temperature difference is small and approaches 2 as the lower temperature approaches zero. The approximation is valid if the temperature of each surface is uniform. Numerical calculations showed that it is also reasonably accurate when the temperature varies with height on the cooler surface. An electrical circuit analogy shows that this should be generally true, but that the approximation may be poor when the hotter surface temperature is not uniform. The appendix shows the derivation of the view factors used in the radiative heat transport calculations.

25004 (UCRL-JC–110081) **Recovery of materials impacted at high velocity.** Nellis, W.J.; Gratz, A.J. Lawrence Livermore National Lab., CA (United States). Dec 1992. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-921162–16: Hypervelocity impact symposium, Austin, TX (United States), 17-20 Nov 1992). Order Number DE93014150. Source: OSTI; NTIS; GPO Dep.

Hypervelocity impact can produce unique effects in materials. including crystal structures, microstructures, and properties. Examples include impact-driven shock waves to synthesize novel materials 1 mm and 1 μm thin shocked to pressures up to 100 GPa (1 Mbar), preferential crystallographic alignment achieved by taking into account the shape and size of powder particles, and high-pressure phase transitions quenched in geological materials. Thin specimens are used to achieve the highest quench rates. Methods are described which show that the experiments can be performed by precooling or preheating specimens in the range −170° to +1000°C. Calculational results for the quartz experiments show the importance of computational simulations to determine the pressure history in the specimen.

25005 (UCRL-JC–110564) **Comparison of weak-shock reflection factors for wedges, cylinders and blast waves.** Reichenbach, H. (Fraunhofer-Institut fuer Kurzzeitdynamik - Ernst-Mach-Institut (EMI), Freiburg im Breisgau (Germany)); Kuhl, A.L. Lawrence Livermore National Lab., CA (United States). Jul 1992. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Contract DNA-IACRO-92-824;Contract DNA-001-91-C-0039. (CONF-9207202–1: 10. Mach reflection symposium, Denver, CO (United States), 20-23 Jul 1992). Order Number DE93014120. Source: OSTI; NTIS; GPO Dep.

Ernst Mach (1838–1916) was the first to discover an irregular reflection phenomenon of shock waves, as is well known in our community. In fact, this occurred in 1875 – three years earlier than usually assumed in the literature. A facsimile of the paper in which he mentioned a special shock wave behavior is shown in a figure. However, it is correct that Mach gave the physical interpretation of this phenomenon in 1878. Since Mach's discovery of an irregular shock reflection pattern 117 years ago, new shock configurations have been discovered – one of the most recent examples is the so-called "von Neumann reflection" for weak shocks as reported by Colella and Henderson in 1990. Due to active research efforts related to shock reflection, especially in the last two decades, we now have a relatively detailed understanding of reflection phenomena and of transition conditions from one reflection configuration to another. The purpose of this paper is to compare reflection factors for weak shocks from various surfaces, and to focus attention on

some unsolved questions. Three different cases are considered: (1) square-wave planar shock reflection from wedges, (2) square-wave planar shock reflection from cylinders and (3) spherical blast wave reflection from a planar surface. The authors restrict themselves to weak shocks. Following Henderson's definition, shocks with a Mach number of $M_0 < 1.56$ in air or with an overpressure of $\Delta p_i < 25$ psi (1.66 bar) under normal ambient conditions are called weak.

25006 (UCRL-JC–111173) **Laser system design for the generation of a sodium-layer laser guide star.** Friedman, H.W. Lawrence Livermore National Lab., CA (United States). Jan 1993. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-930159–32: OE/LASE '93: International Society for Optical Engineering (SPIE) conference, Los Angeles, CA (United States), 16-23 Jan 1993). Order Number DE93014127. Source: OSTI; NTIS; GPO Dep.

The design considerations for a laser system used to generate a sodium-layer guide star are presented. Laser technology developed for the Atomic Vapor Laser Isotope Separation (AVLIS) Program is shown to be directly relevant to this problem and results of a demonstration using the AVLIS laser to generate such a guide star are shown. The design of a compact laser suitable for use at a large telescope such as the Keck is also presented.

25007 (UCRL-JC–111495) **Image reconstruction for x-ray holographic microscopy.** Brase, J.; Yorkey, T.; Trebes, J. Lawrence Livermore National Lab., CA (United States). Sep 1992. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-920792–56: Society of Photo-Optical Instrumentation Engineers (SPIE) international symposium on optical applied science and engineering, San Diego, CA (United States), 19-24 Jul 1992). Order Number DE93013094. Source: OSTI; NTIS; GPO Dep.

This paper gives a basic overview of holography as applied to x-ray microscopy. Topics discussed include fourier transform holography, phase recovery from a hologram, reconstruction of scattered fields, and the use of straight ray approximations. Three dimensional spatial resolution below 100 nm is possible. (GH)

25008 (UCRL-JC–112713) **Turbulent wall jet in blast wave precursor.** Kuhl, A.L. Lawrence Livermore National Lab., El Segundo, CA (United States). Jan 1993. 38p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9301100–1: 1993 national symposium on shock waves, Sendai (Japan), 11-15 Jan 1993). Order Number DE93011955. Source: OSTI; NTIS; GPO Dep.

Numerical simulations of the turbulent dusty flow induced by an explosion over a ground surface were performed with a second-order Godunov code. Adaptive Mesh Refinement was used to capture the convective mixing processes on the computational grid. The most prominent feature of the flow was a turbulent wall jet that was induced by the precursor shock refraction into a thermal layer on the surface. Dust lofting occurred because the rotational structures of the boundary layer entrained dust from the ground surface. Scaling methods were defined in order to evaluate the mean and r.m.s. profiles of the wall jet. The profiles were shown to be similar to the profiles calculated for self-similar wall jets propagating over dust layers, and agreed with experimental profiles of a dusty boundary layer behind a shock. The Convective Mixing Model described here can be applied to a wide spectrum of fluid-dynamic mixing problems.

6620 Physics of Elementary Particles and Fields

25009 (DOE/ER/40249–T1) **[Experimental research in high energy physics: Final technical progress report, 1986–1992].** California Univ., Santa Cruz, CA (United States). [1992]. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AT03-86ER40249. Order Number DE93011912. Source: OSTI; NTIS; INIS; GPO Dep.

This is the closeout report for DOE supported research in high energy physics for the period 1986–1992, under contract award AT03-86ER40249 at the Santa Cruz Institute for Particle Physics (SCIPP) at U.C. Santa Cruz. The research during this period consisted primarily of the following: Data taking with the MARK II detector at the SLC at SLAC and construction of a silicon vertex detector for the MARK II. This effort included substantial work on commissioning of the SLC accelerator. Preparation of the SLD experiment for the SLC, and initial data taking with this experiment. Participation in the ALEPH physics program at LEP at CERN in Geneva, with an emphasis on its silicon vertex detector. Analysis of data collected with the MARK III experiment at the SPEAR accelerator at SLAC. Electronics development for the leading proton spectrometer for the ZEUS experiment at DESY in Hamburg. Design, testing and physics studies for a silicon tracker for the SSC. Theoretical physics program emphasizing phenomenology, Higgs physics, supersymmetry, and some issues in cosmology.

25010 (DOE/ER/40672–2) **Elementary particle physics and high energy phenomena: Progress report for FY93.** Barker, A.R.; Cumalat, J.P.; De Alwis, S.P.; DeGrand, T.A.; Ford, W.T.; Mahanthappa, K.T.; Nauenberg, U.; Rankin, P.; Smith, J.G. Colorado Univ., Boulder, CO (United States). Dept. of Physics. Jun 1992. 117p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-91ER40672. (COLO-HEP–314). Order Number DE93013971. Source: OSTI; NTIS; INIS; GPO Dep.

Experimental and theoretical high-energy physics programs at the University of Colorado are reported. Areas of concentration include the following: study of the properties of the Z^0 with the SLD detector; fixed-target K-decay experiments; the R&D program for the muon system: the SDC detector; high-energy photoproduction of states containing heavy quarks; electron–positron physics with the CLEO II detector at CESR; lattice QCD; and spin models and dynamically triangulated random surfaces. 24 figs., 2 tabs., 117 refs.

25011 (DOE/ER/40681–2) **[Experimental and theoretical high energy physics program].** Finley, J.; Gaidos, J.A.; Loeffler, F.J.; McIlwain, R.L.; Miller, D.H.; Palfrey, T.R.; Shibata, E.I.; Shipsey, I.P. Purdue Univ., Lafayette, IN (United States). Dept. of Physics. Apr 1993. 123p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-91ER40681. Order Number DE93013336. Source: OSTI; NTIS; INIS; GPO Dep.

Experimental and theoretical high-energy physics research at Purdue is summarized in a number of reports. Subjects treated include the following: the CLEO experiment for the study of heavy flavor physics; gas microstrip detectors; particle astrophysics; affine Kac–Moody algebra; nonperturbative mass bounds on scalar and fermion systems due to triviality and vacuum stability constraints; resonance neutrino oscillations; e^+e^- collisions at CERN; $\bar{p}$–p collisions at FNAL; accelerator physics at Fermilab; development work for the SDC detector at SSC; TOPAZ; D-zero physics; physics beyond the standard model; and the Collider Detector at Fermilab. (RWR)

25012 (DOE/FTR–93012250) **[Travel to China to give lectures at Shandong University, Qinghua University, and the Institute for High Energy Physics (IHEP)]: Foreign trip report, September 28, 1990–October 15, 1990.** Murphy, C.T. Fermi National Accelerator Lab., Batavia, IL (United States). 1 Oct 1992. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03000. Order Number DE93012250. Source: OSTI; NTIS (US Sales Only); GPO Dep.

My collegues on Fermilab Experiment 771 from Shandong University, Jinan, China, wanted me to come to their university both to give lectures on High Energy Physics for students and to meet with their seniorleaders about our future collaboration. They arranged an invitation from the Ministry of Education, which paid all my expenses after arriving in China. There was an interest on my part to visit both former andpresent collegues at the Institute for High Energy Physics (IHEP), Beijing, and examine their work on our experiments (Fermilab experiments 782 and 740-D-Zero) at their home base. They wanted me to give two lectures at Qinghua University, Beijing, the best technical university in Beijing from which they draw most of their young researchers, so the two institutions jointly sponsored my visit to Beijing. I was accompanied by my wife, also their guest, who gave several lectures on American public health methods in both Beijing and Jinan and toured several hospitals and health facilities. She was enthusiastically received.

25013 (ORNL/FTR–4184) **Participation in the WA93 Collaboration meeting at CERN, and the second international**

workshop on software engineering, artificial intelligence, and expert systems for high energy and nuclear physics: Foreign trip report, January 3–20, 1992. Awes, T.C. Oak Ridge National Lab., TN (United States). 31 Jan 1992. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93011087. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The traveler attended the WA93 collaboration meeting at CERN, January 7–10. The traveler presented a talk on a method to estimate the combinatorial background using event mixing in order to obtain a more reliable extraction of the π^0 and η yield for the direct photon analysis. The traveler also presented current plans and simulation results for the PHENIX detector at RHIC. The traveler attended the Second International Workshop on Software Engineering, Artificial Intelligence, and Expert Systems for High Energy and Nuclear Physics.

6621 General Theory of Particles and Fields

Refer also to citation(s) 25029, 25046, 25054, 25223

25014 (DOE/ER/40427–32-N92) **Discrete space-time symmetries.** Henley, E.M. Washington Univ., Seattle, WA (United States). Dept. of Physics. [1992]. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG06-88ER40427. (CONF-9209332–1: Indian summer school, Sazava (Czech Republic), 7-10 Sep 1992). Order Number DE93010199. Source: OSTI; NTIS; INIS; GPO Dep.

Symmetries have always fascinated human beings; they are found in nature, art, and architecture. Physicists, like other scientists have often used symmetries as a basis of their understanding of nature. When the dynamics is unknown, symmetries serve to delineate and define it. When the dynamics is known, symmetries are used to study structure. These two lectures review the theory and present understanding and status of two discrete space-time symmetries,, namely parity (P) and time reversal (T).

25015 (DOE/ER/40427–36-N92) **Aspects of symmetry violation.** Henley, E.M. Washington Univ., Seattle, WA (United States). Dept. of Physics. [1992]. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG06-88ER40427. (CONF-921131–12: 10. international symposium on high-energy spin physics, Nagoya (Japan), 9-14 Nov 1992). Order Number DE93011003. Source: OSTI; NTIS; INIS; GPO Dep.

Violations of symmetries have been used to determine (or test) the theoretical dynamics or to study structure. Recent experiments on parity non-conservation and time reversal symmetry, and that depend on spin properties, are used to illustrate both applications.

25016 (JINR-D–2-92-44) **On the nature of mirror particles.** Takhtamyshev, G.G. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of Computing Techniques and Automation. 1992. [12p.] Order Number DE93626670. Source: OSTI; NTIS (US Sales Only); INIS.

Consequences of the experiments demonstrating non-conservation of spatial and combined (CP) parity are considered. A hypothesis is proposed according to which the results of the experiments do not contradict the mirror symmetry of our World. According to the hypothesis the fundamental particles (quarks and leptons) consist of moving constituents which do not possess charges of any of the three known interactions. Strong, weak and electromagnetic interactions arise as a result of internal motion of the constituents; on reversal of the direction of this motion a particle transforms into its antiparticle, whereas spatial inversion transforms usual particles into mirror ones (and vice versa). Consequences of the hypothesis for neutral kaons system are also considered and some experiments aimed at searching for mirror particles are suggested. 12 refs.

25017 (JINR-E–2-92-270) **Renormalizations in supersymmetric and nonsupersymmetric non-abelian Chern-Simons field theories with matter.** Avdeev, L.V.; Kazakov, D.I.; Kondrashuk, I.N. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of Theoretical Physics. 1992. [22p.] Order Number DE93626646. Source: OSTI; NTIS (US Sales Only); INIS.

Submitted to Nucl. Phys., B.

We explicitly carry out the renormalization of nonabelian Chern-Simons field theories with matter in (2+1 dimensions). All the renormalization constants are calculated to the leading two-loop order both in terms of component fields and N=1 superfields for the fundamental representation of the SU(n), Sp(n) and SO(n) groups. Renormalization-group fixed points are found, and their stability properties are examined. It is shown that the N=2 supersymmetry is realized as an infrared fixed-point solution, where the ultraviolet divergencies cancel. 12 refs.; 2 figs.; 4 tabs.

25018 (JINR-E–4-92-282) **Supersymmetry of gauge equations and geometric nonadiabatic phases.** Suzko, A.A. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of Theoretical Physics. 1992. [11p.] Order Number DE93626671. Source: OSTI; NTIS (US Sales Only); INIS.

Submitted to Physics Letters.

It is shown that nondiagonal elements of the connection operator A generate the nonadiabatic geometric phase in addition to Aharonov-Anandan one. The extra geometric phases are produced by A-singularities arising due to crossing of potential curves and in certain case of supersymmetry. The supersymmetric extension for the system of gauge equations is discussed. 15 refs.

25019 (JINR-E–5-92-326) **One-dimensional anharmonic oscillator in self- similar approximation.** Yukalova, E.P.; Yukalov, V.I. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of Theoretical Physics. 1992. [15p.] Order Number DE93626645. Source: OSTI; NTIS (US Sales Only); INIS.

A new method, called the method of self-similar approximations, is applied here for calculating the spectrum of the one-dimensional anharmonic oscillator. The advantage of this method is the possibility of reconstructing any sought function using only two first terms of perturbation theory. Notwithstanding such a limited information, the whole spectrum of the anharmonic oscillator can be found with a very good accuracy for all energy levels and all anharmonicity constants with the maximal error of an order 10^{-3}. 20 refs.; 2 tabs.

25020 (LA-UR–93-1511) **Parity nonconservation in proton scattering at higher energies.** Mischke, R.E. Los Alamos National Lab., NM (United States). [1993]. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930389–6: Future directions in particle and nuclear physics at multi-GeV hadron beam facilities, Upton, NY (United States), 4-6 Mar 1993). Order Number DE93012743. Source: OSTI; NTIS; INIS; GPO Dep.

A parity-nonconservation experiment in the scattering of longitudinally-polarized protons at an incident proton momentum of 6 GeV/c is examined. This experiment indicates a sharp rise with energy of the total cross section correlated with proton helicity that was unexpected. This energy dependence is due to the strong part of the interaction and may indicate the role of a diquark component in the nucleon. New experiments at higher energies are needed to confirm such a model. Future experiment can benefit from an analysis of sources of systematic error that have been encountered in the experiment discussed here.

6622 Specific Theories and Interaction Models; Particle Systematics

Refer also to citation(s) 25050, 25094, 25102

25021 (BNL–48736) **Searches for strangelets and other exotics at the AGS.** Pile, P.H. Brookhaven National Lab., Upton, NY (United States). [1993]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-930173–6: HIPAGS meeting, Cambridge, MA (United States), 14-17 Jan 1993). Order Number DE93013341. Source: OSTI; NTIS; INIS; GPO Dep.

This article describes some experiments either completed, in progress or planned at the Brookhaven National Laboratory AGS. In particular, the experiments described are searches for exotic forms of matter. The existence of such matter could provide a clear signature for the deconfinement or rearrangement of quarks outside the bounds of normal baryons.

25022 (BNL–48760) **Standard model status (in search of "new physics").** Marciano, W.J. Brookhaven National Lab., Upton, NY (United States). Mar 1993. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-930389–3: Future directions in particle and nuclear physics at multi-GeV hadron beam facilities, Upton, NY (United States), 4-6 Mar 1993). Order Number DE93013288. Source: OSTI; NTIS; INIS; GPO Dep.

A perspective on successes and shortcomings of the standard model is given. The complementarity between direct high energy probes of new physics and lower energy searches via precision measurements and rare reactions is described. Several illustrative examples are discussed.

25023 (DOE/ER/40272–182) **Symmetric textures.** Ramond, P. (Florida Univ., Gainesville, FL (United States). Dept. of Physics). Florida Univ., Gainesville, FL (United States). Inst. for Fundamental Theory. [1993]. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG05-86ER40272. (UFIFT-HEP–93-7;CONF-9301103–1: Global Foundation International conference on unified symmetry in the small and in the large, Coral Gables, FL (United States), 25-27 Jan 1993). Order Number DE93011589. Source: OSTI; NTIS; INIS; GPO Dep.

The Wolfenstein parametrization is extended to the quark masses in the deep ultraviolet, and an algorithm to derive symmetric textures which are compatible with existing data is developed. It is found that there are only five such textures.

25024 (DOE/ER/40561–098) **Finite temperature QCD sum rules reexamined: ρ, ω, and A_1 mesons.** Hatsuda, Tetsuo (Washington Univ., Seattle, WA (United States). Inst. for Nuclear Theory); Koike, Yuji; Lee, Su Houng. Washington Univ., Seattle, WA (United States). Inst. for Nuclear Theory. [1992]. 35p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG06-90ER40561 ;FG05-87ER40322. Order Number DE93011005. Source: OSTI; NTIS; INIS; GPO Dep.

A new formulation of the QCD sum rules at finite temperature (T) is developed. Because of the factorization in the operator product expansion, all the soft dynamics including the effect of finite T in the hadronic phase is taken into account in the thermal average of local operators $\langle$script-O$\rangle_T$. Unlike T = 0 case, (script-O)$_T$ has non-vanishing values for the Lorentz nonscalar operators such as $\bar{q}\gamma_\mu D_{\nu_1}q$. On the basis of the observation that the finite temperature medium can be well approximated by a dilute (non-interacting) pion gas at low T, one can make a sensible estimate of the T-dependence of various condensates, where the current algebra and the experimental information of the pion structure functions turn out to be a useful guide. This method is applied to the light vector mesons (ρ, ω and A_1), and it is found that the change of the four-quark condensate at T $\neq$ 0 is crucial to cause their mass shift. Associated with the partial restoration of the chiral symmetry, the ρ and A_1 meson masses obtained by the Borel sum rules decrease as T increases. The ω meson mass is rather stable at low T because of its iso-inglet nature. The lepton pair production rate from the hot hadronic medium near the ρ-resonance is calculated using the result of the sum rules and a considerable spectral change is shown above T = 160 MeV. This has direct relevance to the detection of the lepton pairs in the future projects of the ultra-relativistic heavy ion collisions such as RHIC and LHC.

25025 (JINR-E–2-92-103) **Quark-loop effects in high energy spin-flip processes.** Goloskokov, S.V. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of Theoretical Physics. 1992. [15p.] Order Number DE93626692. Source: OSTI; NTIS (US Sales Only); INIS.

On the basis of QCD model at large distances is analyzed the qq-sea contribution to the spin effects in the s->∞, t - fixed limit, it is shown that such effects lead to the spin-flip amplitude growing as s. The magnitude of spin-flip and spin-nonflip amplitudes is estimated within some models for quark and gluon propagators. The relative role of spin effects the wave function and the elementary quark subprocess is discussed too. It is shown that the quark-sea effects in the scattering amplitude can reach 30-40% oof the contribution of the simple two-gluon exchange at small momenta transfer. 10 refs.; 4 figs.

25026 (JINR-E–2-92-268) **Mesons at finite temperature in the NJL model with gluon condensate.** Ebert, D.; Kalinovskij, Yu.L.; Volkov, M.K. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of Theoretical Physics. 1992. [10p.] Order Number DE93626697. Source: OSTI; NTIS (US Sales Only); INIS.

Submitted to Phys. Lett., Sect. B.

The QCD-motivated NJL-model with gluon condensate is studied at finite temperature and baryon number density. We investigate the behaviour of the constituent quark mass, quark condensate, meson masses, F_π, coupling constants $g_{\pi qq-bar}$, $g_{\sigma qq-bar}$ and Z as function of temperature T. It is shown that the gluon condensate plays a stabilizing role for behaviour of different physical quantities when temperature changes. 15 refs.; 5 figs.

25027 (JINR-E–2-92-269) **Multipolar-like form of nonabelian gauge theories.** Shirokov, M.I. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of Theoretical Physics. 1992. [14p.] Order Number DE93626690. Source: OSTI; NTIS (US Sales Only); INIS.

Submitted to Ann. Phys.

A notion of the multipolar form of QED is exemplified by using its version valid for neutral systems such as two unlike charges. A new potential-like term $P_{perpendicular}$ arises in the multipolar Hamiltonian. It is shown to be a confining potential in a regularized variant of the multipolar form. This attracts interest to the discussion of multipolar-like form of nonabelian theories. The form is constructed for the case of nonquantized quarks intaracting with gluons. A confining potential is shown to arise which is similar to $P_{perpendicular}$. But its relevance to the quark confinement problem requires further investigations. 17 refs.

25028 (JINR-E–2-92-329) **Statistical approach to deconfinement in pure gauge models.** Shanenko, A.A.; Yukalova, E.P.; Yukalov, V.I. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of Theoretical Physics. 1992. [28p.] Order Number DE93626698. Source: OSTI; NTIS (US Sales Only); INIS.

Submitted to Z. Phys., C.

We suggest a new statistical approach for considering deconfinement in SU(2) and SU(3) gluon systems. A mixture of coexisting glueballs and of the gluon plasma is shown to be thermodynamically more profitable than the corresponding pure phases. The interactions of gluons and glueballs are taken into account. Our results are in a very good agreement with numerical lattice calculations. 38 refs.; 11 figs.

25029 (LBL–33232) **Some new/old approaches to QCD.** Gross, D.J. Lawrence Berkeley Lab., CA (United States). Nov 1992. 20p. Sponsored by USDOE, Washington, DC (United States); National Science Foundation, Washington, DC (United States). DOE Contract AC03-76SF00098. Grant PHY90-21984. (CONF-9209333–1: STRINGS '92, Rome (Italy), 2-8 Sep 1992). Order Number DE93010451. Source: OSTI; NTIS; INIS; OSTI; NTIS; INIS; GPO Dep.

In this lecture I shall discuss some recent attempts to revive some old ideas to address the problem of solving QCD. I believe that it is timely to return to this problem which has been woefully neglected for the last decade. QCD is a permanent part of the theoretical landscape and eventually we will have to develop analytic tools for dealing with the theory in the infra-red. Lattice techniques are useful but they have not yet lived up to their promise. Even if one manages to derive the hadronic spectrum numerically, to an accuracy of 10% or even 1%, we will not be truly satisfied unless we have some analytic understanding of the results. Also, lattice Monte-Carlo methods can only be used to answer a small set of questions. Many issues of great conceptual and practical interest-in particular the calculation of scattering amplitudes, are thus far beyond lattice control. Any progress in controlling QCD in an explicit analytic, fashion would be of great conceptual value. It would also be of great practical aid to experimentalists, who must use rather ad-hoc and primitive models of QCD scattering amplitudes to estimate the backgrounds to interesting new physics. I will discuss an attempt to derive a string representation of QCD and a revival of the large N approach to QCD. Both of these ideas have a long history, many theorist-years have been devoted to their pursuit-so far with little success. I believe that it is time to try again. In part this is because of the progress in the last few years in string theory. Our

increased understanding of string theory should make the attempt to discover a stringy representation of QCD easier, and the methods explored in matrix models might be employed to study the large N limit of QCD.

25030 (RAL–92-078) **Parton distributions updated.** Martin, A.D. (Durham Univ. (United Kingdom). Dept. of Physics); Stirling, W.J.; Roberts, R.G. Rutherford Appleton Lab., Chilton (United Kingdom). Nov 1992. [12p.] (DTP–92/80.). Order Number DE93626699. Source: OSTI; NTIS (US Sales Only); INIS.

We refine our recent determination of parton distributions with the inclusion of the new published sets of precise muon and neutrino deep inelastic data. Deuteron screening effects are incorporated. The tt-bar cross section at the Fermi National Accelerator Laboratory (FNAL) pp-bar collider is calculated. (author).

6623 Specific Interactions, Decays and Processes

Refer also to citation(s) 24350, 25009, 25015, 25025, 25030, 25052, 25089, 25090, 25091, 25102

25031 (BNL–48595) **Strangeness production with protons and pions.** Dover, C.B. Brookhaven National Lab., Upton, NY (United States). [1993]. 19p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-930239–1: We-Heraeus seminar: hadronic processes at small angles in storage rings, Bad Honnef (Germany), 1-3 Feb 1993). Order Number DE93010879. Source: OSTI; NTIS; INIS; GPO Dep.

We discuss the spectrum of physics questions related to strangeness which could be addressed with intense beams of protons and pions in the few GeV region. We focus on various aspects of strangeness production, including hyperon production in pp collisions, studies of hyperon-nucleon scattering, production of hypernuclei in proton and pion-nucleus collisions, and spin phenomena in hypernuclei.

25032 (BNL–48648) **HIJET with AGS physics and N*'s.** Longacre, R.S. Brookhaven National Lab., Upton, NY (United States). 11 Feb 1993. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016 ;FG05-87ER40309 ;FG02-91ER40645 ;FG02-88ER40413. (CONF-930173–7: HIPAGS meeting, Cambridge, MA (United States), 14-17 Jan 1993). Order Number DE93014022. Source: OSTI; NTIS; INIS; GPO Dep.

We investigate the effects of secondary interactions in nucleus-nucleus and proton-nucleus collisions using a modified HIJET Monte Carlo generator. The effects of N* production is explored and it is found that the numbers of kaons can almost be explained by their inclusion. However the transverse momentum spectrum of the kaons is not explained, since their production in HIJET is a soft secondary scattering process and not a hot thermal process like the data.

25033 (CONF-9203159–9) **A review of two photon production of jets at PEP and PETRA energies.** Kofler, R.R. Massachusetts Univ., Amherst, MA (United States). Dept. of Physics and Astronomy. [1992]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-85ER40194. From 9. international workshop on photon-photon collisions; San Diego, CA (United States); 22-26 Mar 1992. Order Number DE93011742. Source: OSTI; NTIS; INIS; GPO Dep.

Experimental results on the production of hadron jets in photon-photon interactions at PETRA and PEP are reviewed with special emphasis on the recent results from the TPC/2γ experiment at PEP. All results have been compared with the predictions of Vector Dominance and Quark Parton Models and the experiments all find excess jet production at low Q^2 and intermediate transverse momentum which cannot be explained on the basis of the simple VDM + QPM models.

25034 (CONF-921122–54-App.1) **Double semi-leptonic charm decay in helios-I 450 GeV/c p-Be data: Appendix 1.** Pierre, A. (Montreal Univ., PQ (Canada). Dept. of Physics); Pominanowski, P.A. Montreal Univ., PQ (Canada). Dept. of Physics. [1992]. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-91ER40646. From Meeting of the Division of Particles and Fields of the American Physical Society; Batavia, IL (United States); 10-14 Nov 1992. Order Number DE93013493. Source: OSTI; NTIS; INIS; GPO Dep.

Data taken in 1989 by HELIOS-I (NA34) at the CERN SPS (450 GeV/c proton beam on Be target) have been examined for $e^{\pm}\ \mu^{\mp}$ or $\mu^{\pm}\ \mu^{\mp}$ pairs with associated missing energy. Such pairs arise from semi-leptonic decay of both members of a $c\bar{c}$ pair. The $e\mu$ and $\mu\mu$ samples are consistent with expectations from charm decay, allowing a quantitative limit to be placed on other physics.

25035 (DOE/ER/40646–3) **Experimental particle physics at the University of Pittsburgh: Progress report, November 1, 1992–October 31, 1993.** Cleland, W.E.; Engels, E. Jr.; Humanic, T.J.; Perera, U.; Shepard, P.F.; Thompson, J.A. Pittsburgh Univ., PA (United States). Dept. of Physics and Astronomy. Apr 1993. 215p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-91ER40646. Order Number DE93013326. Source: OSTI; NTIS; INIS; GPO Dep.

During the past year on Task A, the HELIOS work drew to a close with first results from the electron-muon pair studies (no anomalous sources are seen, and the final results and uncertainties are being set). First data from CMD2 will allow improvement of some phi branching ratios, including some improved limits on forbidden decays. The engineering run for E865 is scheduled for June and July of 1993. The principal efforts of Task B, the Fermilab program, have been the completion of the analysis of the 1987–88 data with resulting publications, completion of the 1990–91 data run, and the beginning of the analysis of the 1990–91 data. In addition, the Task B group is taking a leadership role in developing a proposal to Fermilab for the upgrade of the CDF silicon vertex detector in preparation for the 1995 data run. Task C has recently submitted results of its fractionally charged particle searches, placing new upper limits on the abundance of naturally-occurring fractionally-charged particles in various materials. This group has recently been approved by the Brookhaven management for an exposure of their p-i-n diodes in a high intensity proton beam. This measurement, along with its subsequent analysis, will complete the program. Task D concerned itself with silicon drift chamber studies for the SSC. Task E was devoted to studies of electronics for the GEM Level 1 liquid Ar calorimeter trigger.

25036 (FNAL/C–93/047/E) **Inclusive jet cross sections at the Dν detector.** Astur, R.V. (State Univ. of New York, Stony Brook, NY (United States). Dept. of Physics). Fermi National Accelerator Lab., Batavia, IL (United States). Nov 1992. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03000. (CONF-921122–51: Meeting of the Division of Particles and Fields of the American Physical Society, Batavia, IL (United States), 10-14 Nov 1992). Order Number DE93012778. Source: OSTI; NTIS; INIS; GPO Dep.

The D0 calorimeter gives uniform response, hermetic coverage and stable calibration for detection of jets produced in $p\bar{p}$ collisions out to a pseudo-rapidity $|\eta| = 4.1$. Jet triggers are implemented for $|\eta| \leq 3.2$. We present preliminary distributions for inclusive jet production versus p_T.

25037 (FNAL/C–93/051-E) **Top quark search in Dν from the lepton + jets mode.** Klima, B. For the DO Collaboration. Fermi National Accelerator Lab., Batavia, IL (United States). Nov 1992. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03000. (CONF-921122–58: Meeting of the Division of Particles and Fields of the American Physical Society, Batavia, IL (United States), 10-14 Nov 1992). Order Number DE93014027. Source: OSTI; NTIS; INIS; GPO Dep.

The D0 collaboration has searched for Top quark production at $\sqrt{s} = 1.8$ TeV in $p\bar{p}$ collisions at Fermilab using a data sample corresponding to an integrated luminosity of 1.1 pb^{-1}, collected during the 1992 Tevatron run. We report the preliminary results of a search for $t\bar{t}$ production in which the Top quark decays to a W boson plus ab quark where one W decaying leptonically and the other decaying hadronically. Future prospects for extending the search for Top in the lepton plus jets channel are discussed.

25038 (IFVE-OMVT–90-75) **HECAR program package to calculate the cross sections for 2→3 reaction in electroweak interaction theory.** Larin, V.N.; Tikhonin, F.F. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov

(Russian Federation). Inst. Fiziki Vysokikh Ehnergij. 1990. [22p.] (In Russian). Order Number DE93626707. Source: OSTI; NTIS (US Sales Only); INIS.

Submitted to the collection 'Algorithms and algorithmic languages'.

A method for calculating the cross sections of physical processes is described in the framework of computer algebra system HECAS. It consists of two stages. The first is the obtaining of matrix element product MM^+, summed, if necessary, over final spins and averaged over the initial ones. The second stage is the procedure of removing of two particles out of an arbitrary number of them in the phase space. Here M may contain elements of arbitrary complexity obtained in the standard perturbative theory for the case of tree diagrams. The examples of using HECAS-program package in the case of $2 \rightarrow 3$ reaction are given. 16 refs.; 1 tab.

25039 (ISN–92-106) **Contribution at the study of nucleon-antinucleon interaction at low energy and at the proton-antiproton transition in two pions or kaons.** Elchikh, M. Grenoble-1 Univ., 38 (France). Inst. des Sciences Nucleaires. Oct 1992. [118p.] (In French). Order Number DE93626720. Source: OSTI; NTIS (US Sales Only); INIS.

This thesis contains a semi-phenomenological study of the Nucleon-Antinucleon interaction at low energy, and in particular of the annihilation of Proton-Antiproton system into two charged pions or kaons. This annihilation reaction is calculated within the DWBA (Distorted-Wave Born-Approximation) formalism: the transition into two mesons is treated as perturbation around the solution computed out of the whole interaction, including elastic forces and absorption. We first review the optical-potential models which describe the Nucleon-Antinucleon scattering in term of meson exchange supplemented by a complex core to simulate the effects of absorption. Those optical potentials provide the initial state for the annihilation reactions. The transition itself is described by mean of two models, a local one and a separable one. As for the local model, the results are generally in good agreement with experimental data, especially for the analyzing power, but the backward hemisphere for annihilation into two kaons cannot be reproduced. The separable model restricts the transition to S and P waves only, but leads rather naturally to an enhancement of the P wave with respect to the S wave, improving the global description of the angular distribution. This P to S ratio is intimately connected to the relative weight of quark annihilation and quark rearrangement diagrams. The true dynamics of those annihilation reactions presumably mixes our two models, with a transition operator being almost local in the high partial waves and nearly separable for the S and the P waves.

25040 (JINR-E–2-92-51) **Production of D-mesons in pp-collisions and quark-gluon string model.** Lykasov, G.I.; Sergeenko, M.N. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of Nuclear Problems. 1992. [12p.] Order Number DE93626721. Source: OSTI; NTIS (US Sales Only); INIS.

The calculation results of the inclusive spectra of D-mesons produced in pp-collisions as the functions of the Feynman variable x and transverse momentum P-I are presented in the frame of the Quark-gluon string model. The satisfactory description of the experimental data in the frame of QGSM indicated domination of the peripheral mechanism of the D-meson production at high energies, 28 refs.; 6 figs.

25041 (JINR-E–2-92-89) **Large radiative corrections to the lowest-order processes in standard model.** Ivkin, A.V. (AN Kazakhskoj SSR, Alma-Ata (Kazakhstan). Inst. Fiziki Vysokikh Ehnergij); Koltochnic, S.N.; Nazirov, M.T.; Kuraev, E.A. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of Theoretical Physics. 1992. [10p.] Order Number DE93626709. Source: OSTI; NTIS (US Sales Only); INIS.

Submitted to Nucl. Phys., B.

A scheme of calculation of logarithmically large radiations corrections (RC) to Born processes in the frame of the Standard Model (SM) for high energies is developed. Large values of RC are revealed for $e^+e^- \rightarrow W^+W^-$, ZZ, $Z\gamma$ both in the total cross-sections and in the differential ones, whereas they are absent in $\gamma\gamma$-collisions. This fact results in the effect of 'nonmonochromatism' of $e^\pm$-beams at lepton colliders with fixed energies higher than $\sqrt{s}>500$ GeV, which is analogous to nonmonochromatism of γ-beams produced by laser conversion. 14 refs.; 11 figs.

25042 (KFKI–1992-13/A) **Analysis of the KW distribution using a generalization of the Meijer's G-function.** Krasznovszky, S. (Hungarian Academy of Sciences, Budapest (Hungary). Central Research Inst. for Physics). Hungarian Academy of Sciences, Budapest (Hungary). Central Research Inst. for Physics. Mar 1992. [15p.] Order Number DE93626722. Source: OSTI; NTIS (US Sales Only); INIS.

The Krasznovszky-Wagner (KW) distribution can be used as a multiplicity distribution describing the hadron-hadron interactions and the e^+e^- annihilation for LEP energy. With the aid of the H-function of Fox the characteristic function of the KW distribution and the distributions of products, quotients and powers of independent KW-function variates were calculated. The KW distribution includes as special cases many of classical distributions, e.g., the exponential, the gamma, the chi-square, the Weibull, as well as some others which appear in physics. Several examples in connection with statistics and KNO scaling are given. (author) 19 refs.; 1 tab.

25043 (LA-UR–93-1388) **Eta production at the LAMPF P^3 channel.** Zumbro, J.D. Los Alamos National Lab., NM (United States). [1993]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930389–8: Future directions in particle and nuclear physics at multi-GeV hadron beam facilities, Upton, NY (United States), 4-6 Mar 1993). Order Number DE93012679. Source: OSTI; NTIS; INIS; GPO Dep.

We discuss the pion flux that would be available at the P^3 channel at LAMPF with modifications to east leg of the channel. Modifications involve tayloring the optics of the channel to match the pion beam into a section of superconducting linac in both transverse dimensions and also longitudinally. The performance of this channel with these modification is discussed. The possible η flux with this channel is also discussed.

25044 (LA-UR–93-1471) $\mu^+ \rightarrow e^+\gamma$. Cooper, M.D. MEGA collaboration. Los Alamos National Lab., NM (United States). [1993]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9304145–1: International workshop on low energy muon science (LEMS '93), Santa Fe, NM (United States), 4-8 Apr 1993). Order Number DE93012750. Source: OSTI; NTIS; INIS; GPO Dep.

The MEGA experiment at LAMPF is the only current search for $\mu^+ \rightarrow e^+\gamma$ underway. The limit on this rare muon-decay process tests the standard model of electroweak interactions. This report covers the status of the analysis of data taken in 1992 and the prospects for future improvements.

25045 (LA-UR–93-1502) **Some outstanding issues in pion scattering at energies above the Δ resonance.** Morris, C.L.; Zumbro, J.D. Los Alamos National Lab., NM (United States). [1993]. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930389–7: Future directions in particle and nuclear physics at multi-GeV hadron beam facilities, Upton, NY (United States), 4-6 Mar 1993). Order Number DE93012747. Source: OSTI; NTIS; INIS; GPO Dep.

The $\Delta(1232)$ resonance dominates pion-nucleon scattering at energies below 300 MeV, the region in which pion-nucleus scattering has been well studied using spectrometers at the meson factories. Above this energy region little pion-nucleus scattering data exists. Recently, spectrometers at Brookhaven, LAMPF, KEK, and DUBNA have been used to obtain initial data for pion-nucleus scattering in this energy region. In this talk we review some data that have been obtained using the LAS spectrometer at LAMPF.

25046 (LA-UR–93-1532) **No-lost "Theorem" for parity violating nucleon-nucleon scattering experiments.** Goldman, T. Los Alamos National Lab., NM (United States). [1993]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930389–10: Future directions in particle and nuclear physics at multi-GeV hadron beam facilities, Upton, NY (United States), 4-6 Mar 1993). Order Number DE93012737. Source: OSTI; NTIS; GPO Dep.

A purely left-chiral model of the weak interactions is used to show that the total parity-violating asymmetry in quark-quark scattering must grow with increasing energy. In the absence of other new physics, non-observation of a large asymmetry can therefore be used to infer an upper bound on the mass scale for new right-chiral weak vector bosons. Applying this idea to actual nucleon-nucleon scattering requires more involved calculations, as the dominant contribution appears to come from a component of diquark-quark scattering related to, but not identical to, wavefunction-mixing. Earlier criticism of this model by Simonius and linger is refuted, and a new calculation is proposed as an additional check on the result. Finally, we argue that the so-called 'spin crisis' does not affect our conclusions.

25047 (ORNL/FTR–4336) **[Travel to attend the NATO Advanced Study Institute held at Il Ciocco, Italy]: Foreign trip report, July 10–26, 1992.** Young, G.R. Oak Ridge National Lab., TN (United States). 6 Aug 1992. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93012242. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The traveler attended the NATO Advanced Study Institute on Particle Production in Highly Excited Matter held at Il Ciocco, Castelvecchio Pascoli, Italy, from July 13–24, 1992. He presented two 1-hour lectures: the first concerning basic processes producing continuum electromagnetic radiation in p - A collisions and related experimental data and the second extending the discussion of data and rates to heavy-ion collisions, with emphasis on detection of such radiation at RHIC. The broad area of relativistic heavy-ion collisions was covered by some 35 lecturers in a manner intended to be accessible to students within 2 to 3 years of the Ph.D degree. Several presentations were given by students.

25048 (SLAC–409) **Strange meson spectroscopy in Kω and Kϕ at 11 GeV/c and Cherenkov ring imaging at SLD.** Kwon, Youngjoon. Stanford Linear Accelerator Center, Menlo Park, CA (United States). Jan 1993. 286p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00515. Order Number DE93013593. Source: OSTI; NTIS; INIS; GPO Dep.

This thesis consists of two independent parts; development of Cherenkov Ring Imaging Detector (CRID) system and analysis of high-statistics data of strange meson reactions from the LASS spectrometer. Part 1: The CRID system is devoted to charged particle identification in the SLAC Large Detector (SLD) to study e^+e^- collisions at $\sqrt{s} = m_{Z^0}$. By measuring the angles of emission of the Cherenkov photons inside liquid and gaseous radiators, π/K/p separation will be achieved up to ~30 GeV/c. The signals from CRID are read in three coordinates, one of which is measured by charge-division technique. To obtain a ~1% spatial resolution in the charge-division, low-noise CRID preamplifier prototypes were developed and tested resulting in <1000 electrons noise for an average photoelectron signal with 2×10^5 gain. To help ensure the long-term stability of CRID operation at high efficiency, a comprehensive monitoring and control system was developed. Part 2: Results from the partial wave analysis of strange meson final states in the reactions $K^-p \to K^-\omega p$ and $K^-p \to \bar{K}^0\phi n$ are presented. The analyses are based on data from a 4.1 event/nb exposure of the LASS spectrometer in K^-p interactions at 11 GeV/c. The data sample of $K^-\omega p$ final state contains ~10^5 events. From the partial wave analysis, resonance structures of $J^P = 2^-$, 3^- and 2^+ amplitudes are observed in the Kω system. The analysis of 2^- amplitudes provides an evidence for two strange meson states in the mass region around 1.75 GeV/c^2. The appropriate branching fractions are calculated and compared with the SU(3) predictions. The partial wave analysis of $\bar{K}^0\phi$ system favors $J^P = 1^-$ and 2^+ states in the 1.9–2.0 GeV/c^2 region.

25049 (SLAC-PUB–6068) **Novel spin effects in quantum chromodynamics.** Brodsky, S.J. Stanford Linear Accelerator Center, Menlo Park, CA (United States). Feb 1993. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00515. (CONF-921131–10: 10. international symposium on high-energy spin physics, Nagoya (Japan), 9-14 Nov 1992). Order Number DE93010955. Source: OSTI; NTIS; INIS; GPO Dep.

This report discusses a number of interesting hadronic spin effects which test fundamental features of perturbative and non-perturbative QCD. These include constraints on the shape and normalization of the polarized quark and gluon structure functions of the proton; the principle of hadron helicity retention in high x_F inclusive reactions; predictions based on total hadron helicity conservation in high momentum transfer exclusive reactions; the dependence of nuclear structure functions and shadowing on virtual photon polarization; and general constraints on the magnetic moment of hadrons. I also will discuss the implications of several measurements which are in striking conflict with leading-twist perturbative QCD predictions, such as the extraordinarily large spin correlation A_{NN} observed in large angle proton-proton scattering, the anomalously large $\rho\pi$ branching ratio of the J/ψ, and the rapidly changing polarization dependence of both J/ψ and continuum lepton pair hadroproduction observed at large x_F.

6624 Properties of Specific Particles and Resonances

Refer also to citation(s) 24989, 25024, 25037, 25040, 25045, 25049

25050 (BNL–48605) **Top and Higgs masses in a composite boson model.** Kahana, D.E. (Kent State Univ., OH (United States). Dept. of Physics); Kahana, S.H. Brookhaven National Lab., Upton, NY (United States). Jan 1993. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-921122–48: Meeting of the Division of Particles and Fields of the American Physical Society, Batavia, IL (United States), 10-14 Nov 1992). Order Number DE93010874. Source: OSTI; NTIS; INIS; GPO Dep.

Recently Nambu as well as Bardeen, Hill and Linden have suggested replacing the Higgs mechanism with a dynamical symmetry breaking generated by four fermion interactions of the top quark. In fact the model for replacing the scalar sector is that of Nambu and Jona-Lasinio (NJL) and one recovers the Higgs as a tt composite. Earlier authors have also treated vector mesons as composites within the NJL framework, with perhaps the earliest suggestion being that of Bjorken for a composite photon. Here we attempt to generate the entire electroweak interaction from a specific current-current, baryon number conserving form of the four fermion interaction. The W, Z and Higgs boson appear as coherent composites of all fermions, quarks and lepton, and not just of the top quark. The four fermion interaction is assumed to be valid at some high mass scale μ, perhaps the low energy limit resulting by the elimination of non-fermionic degrees of freedom from a more basic theory. The cutoff Λ, necessary in the non-renormalizable NJL may be viewed then as the proper scale for this more basic theory.

25051 (FNAL/C–93/054-E) **Electron identification in the Dν detector.** Narain, M. For the DO Collaboration. Fermi National Accelerator Lab., Batavia, IL (United States). Nov 1992. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03000. (CONF-921122–59: Meeting of the Division of Particles and Fields of the American Physical Society, Batavia, IL (United States), 10-14 Nov 1992). Order Number DE93014028. Source: OSTI; NTIS; INIS; GPO Dep.

We present the techniques used to identify electrons in the D0 detector. The D0 electron identification algorithm is based on the full covariance matrix of energy deposits in the calorimeter cells occupied by an electromagnetic shower and information from the central tracking system. The method exploits the fine longitudinal and transverse segmentation of the D0 calorimeter to achieve excellent pion rejection. Performance criteria are derived from test beam electron and pion data and from collider data.

25052 (JINR-R–2-92-35) **Proton angular distribution in the decay of possible diproton resonances.** Lyuboshits, V.L. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of High Energy. 1992. [14p.] (In Russian). Order Number DE93626781. Source: OSTI; NTIS (US Sales Only); INIS.

The classification if a two-proton system with a fixed total angular momentum over LS-states and spherical helicity states is given. Connection between the direction of a two-particle decay and the spin-quantization is discussed. 16 refs.

25053 (LA-UR–93-1243) **The effect of a scalar boson coupled to neutrinos on the behavior of the tritium beta decay spectrum near the end point.** Stephenson, G.J. Jr. Los Alamos National Lab., NM (United States). [1993]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930187–2: 13. Moriond workshop on perspectives in neutrinos, atomic physics, and gravitation, Villars-sur-Ollon (Switzerland), 30 Jan - 6 feb 1993). Order Number DE93012655. Source: OSTI; NTIS; INIS; GPO Dep.

Some consequences of a very light scalar boson coupled only to neutrinos are discussed. In particular, I argue that it is possible to sketch scenarios for the evolution of the Universe in which neutrinos cluster to a local density $\approx 10^{16}$ /cc, that such clusters would be attracted to matter gravitationally, and that the existence of such a neutrino density in the solar system provides an alternative to $m_{-\nu e}^2 < 0$ in fitting tritium beta decay.

25054 (SSCL-Preprint–241) **Quark and lepton masses.** Meshkov, S. Superconducting Super Collider Lab., Dallas, TX (United States). Apr 1993. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-930537–5: 5. annual international industrial symposium on the Super Collider and exhibition; Global Foundation International conference on unified symmetry in the small and in the large, San Francisco, CA (United States); Coral Gables, FL (United S Order Number DE93012308. Source: OSTI; NTIS; INIS; GPO Dep.

The BCS mechanism, augmented by an ad hoc, but reasonable symmetry breaking mechanism, describes both the quark and lepton masses, and is consistent with the constraints imposed by the Cabbibo, Kobayashi, Maskawa mixing matrix. This mechanism may be incorporated into the study of various extensions of the Standard Model such as SUSY SU(5). The symmetry breaking at the unification scale is related to that at experimentally accessible scales by running the coefficients of the terms in the mass matrices characterized by their symmetries.

6630 Nuclear Physics

Refer also to citation(s) 25013, 25463, 25466, 25467, 25468, 25469

25055 (DOE/ER/01067–18) **Triangle Universities Nuclear Laboratory: Annual report, 1 January 1979–31 December 1979: TUNL XVIII.** Triangle Universities Nuclear Lab., Durham, NC (United States). [1979]. 159p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-76ER01067. Order Number DE93013263. Source: OSTI; NTIS; GPO Dep.

1979 research work emphasized such areas as neutron cross section measurements, neutron polarization studies, high-resolution proton elastic and inelastic scattering, charged-particle reactions with polarized beams, radiative capture reactions, nuclear theory and phenomenology, atomic physics, ion source development, accelerator development and instrumentation, and computer-related development. Many brief summaries of specific projects are presented. Although data are included with a number of these, it may reasonably be assumed that completed work is reported in detail in appropriate publications.

25056 (DOE/FTR–93013526) **Participation in the 6th International Conference on Nuclei far from Stability and the International Nuclear Physics Conference: Foreign trip report, July 17–August 10, 1992.** Meyer, R.A. USDOE, Washington, DC (United States). 27 Aug 1992. 10p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93013526. Source: OSTI; NTIS (US Sales Only); GPO Dep.

the purpose of this travel was to attend two conferences: the 6th International Conference on Nuclei far from Stability (in Bernkastel-Kues) and the International Nuclear Physics Conference (in Wiesbaden); and visit three institutions: Hahn-Meitner Institute (Berlin), the University of Frankfurt, and the Forschungszentrum Juelich (Juelich) the last institution of which was visited during vacation.

25057 (INDC(NDS)–213/GM3) **The influence of target and sample properties on nuclear data measurements: Summary report of the IAEA advisory group meeting in co-operation with the International Nuclear Target Development Society (INTDS), held in Darmstadt, Germany, 5-9 September 1988.** Okamoto, K. (ed.) (International Atomic Energy Agency, Vienna (Austria). Nuclear Data Section). International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Oct 1988. [74p.] (CONF-8809159–: 14. world conference of the International Nuclear Target Development Society (INTDS): heavy-ion targets and related phenomena, Darmstadt (Germany), 5-9 Sep 1988). Order Number DE93626092. Source: OSTI; NTIS (US Sales Only); INIS.

The IAEA Advisory Group Meeting (AGM) on The Influence of Target and Sample Properties on Nuclear Data Measurements was held at the Gesellschaft fuer Schwerionenforschung mbH, Darmstadt, Federal Republic of Germany, during the week 5-9 September 1988. The AGM (hereafter "Meeting") was held concurrently during the 14th World Conference (hereafter "Conference") of the International Nuclear Target Development Society (INTDS) in co-operation with the IAEA-International Nuclear Data Committee (INDC). The Meeting's special sessions (5th, 7th and 9th September 1988) were held to review and prepare the summary of the papers presented to the Conference and recommendations on the objectives of the AGM. The contributed papers to the Conference are to be published in the Journal Nuclear Instruments and Methods in Physical Research. The contributed notes to the Meeting's special sessions together with the summary of the contributed papers by the Agency's invitees and the discussions during the Meeting's special sessions and the recommendations are issued in this report. (author). Refs, figs and tabs.

25058 (INDC(NDS)–213/GM3, pp. 11-13) **Some general considerations on the influence of sample characteristics on nuclear data measurements.** Wagemans, C. (Centre d'Etude de l'Energie Nucleaire, Mol (Belgium)). International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Oct 1988. (CONF-8809159–: 14. world conference of the International Nuclear Target Development Society (INTDS): heavy-ion targets and related phenomena, Darmstadt (Germany), 5-9 Sep 1988). In *The influence of target and sample properties on nuclear data measurements: Summary report of the IAEA advisory group meeting in co-operation with the International Nuclear Target Development Society (INTDS), held in Darmstadt, Germany, 5-9 September 1988.* [74p.] Order Number DE93626092. Source: OSTI; NTIS (US Sales Only); INIS.

General considerations about the influence of samples on standard cross-section and other nuclear data measurements are given. 2 refs.

25059 (INDC(NDS)–213/GM3, pp. 64) **On the necessity of alternative methods to determine sample thicknesses and masses.** Wagemans, C. (Centre d'Etude de l'Energie Nucleaire, Mol (Belgium)). International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Oct 1988. (CONF-8809159–: 14. world conference of the International Nuclear Target Development Society (INTDS): heavy-ion targets and related phenomena, Darmstadt (Germany), 5-9 Sep 1988). In *The influence of target and sample properties on nuclear data measurements: Summary report of the IAEA advisory group meeting in co-operation with the International Nuclear Target Development Society (INTDS), held in Darmstadt, Germany, 5-9 September 1988.* [74p.] Order Number DE93626092. Source: OSTI; NTIS (US Sales Only); INIS.

The great impact of an inaccurate determination of the sample mass or the layer thickness on nuclear data measurements is discussed. This is illustrated by selected realistic examples. A short survey of the advantages and disadvantages of various methods to determine the mass or the thickness of a layer is given, especially with respect to their consequences on the accuracy of nuclear data measurements. (author). Abstract only.

25060 (INDC(NDS)–213/GM3, pp. 64-65) **The influence of target properties on nuclear spectroscopy measurements.** Dionisio, J.S. (Centre National de la Recherche Scientifique (CNRS), 91 - Orsay (France)); Vieu, C.; Lagrange, J.M.; Pautrat, M.; Vanhorenbeeck, J.; Passoja, A. International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Oct 1988. (CONF-8809159–: 14. world conference of the International Nuclear Target Development Society (INTDS): heavy-ion targets and related phenomena, Darmstadt (Germany), 5-9 Sep 1988). In *The influence of target and sample properties on nuclear*

data measurements: Summary report of the IAEA advisory group meeting in co-operation with the International Nuclear Target Development Society (INTDS), held in Darmstadt, Germany, 5-9 September 1988. [74p.] Order Number DE93626092. Source: OSTI; NTIS (US Sales Only); INIS.

A broad review of different kinds of in-beam nuclear spectroscopy measurements particularly influenced by the target properties is outlined. To illustrate such an influence a few typical examples of in-beam electron and gamma-ray spectroscopy measurements, performed at the Orsay MP Tandem accelerator, are reported. In particular several applications of the recoil ion catcher method in the study of short-lived nuclear isomers (with half-lives between ten and few hundred nanoseconds) are briefly described. This method is operated mostly with a pulsed heavy ion beam, bombarding a thin self-supported target but avoiding hitting the catcher foil. Moreover, the time of flight filtering properties of this experimental device is improved by a fast detection of compound nucleus deexcitation (performed with an array of several BaF_2 crystals). This kind of measurement shows clearly the importance of the target qualities as well as the need of good focusing properties and time structure for the accelerated particle beam. Finally, the required characteristics of the targets and recoil stopper foils needed for these measurements (and similar ones performed with the recoil ion shadow method) are analyzed in detail for a few typical experimental arrangements. (author). Abstract only.

25061 (UCRL-JC–111831) **The LLNL interactive system for nuclear data evaluation.** Resler, D.A.; White, R.M. Lawrence Livermore National Lab., CA (United States). Oct 1992. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-921046–17: Symposium on nuclear data evaluation methodology, Upton, NY (United States), 12-16 Oct 1992). Order Number DE93013350. Source: OSTI; NTIS; INIS; GPO Dep.

LLNL's interactive system for nuclear data evaluation uses a general-purpose two-dimensional graphics code, QPX. With simple commands, the authors access and plot any information in the Livermore evaluated neutron data library (ENDL), activation library (ACTL), or charged-particle library (ECPL), the Livermore experimental cross section information library (ECSIL), or any evaluated data library using the ENDF format. Features of this system important to evaluation work are discussed. The conversion of evaluations from the ENDF format to the ENDL format for use in this system is discussed.

6631 Nuclear Structure

Refer also to citation(s) 23958, 25093, 25097

25062 (ANL/PHY/CP–79192) **Structure and reactions of light neutron rich nuclei.** Esbensen, H. Argonne National Lab., IL (United States). Physics Div. [1993]. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-930275–3: RIKEN international workshop on heavy-ion fusion reactors with neutron-rich beams, Saitama (Japan), 18-20 Feb 1993). Order Number DE93010656. Source: OSTI; NTIS; INIS; GPO Dep.

Radioactive beam experiments have made it possible to study the structure of nuclei at the neutron drip line. Pair correlations play a crucial role in such nuclei and characteristic features include an extended neutron halo density and a large dipole strength near threshold. The most detailed studies have been performed for ^{11}Li. I will present a 3-body model that explains the main features of the data obtained for this nucleus.

25063 (CONF-9205108–19) **Tracking intruder states.** Riedinger, L.L.; Mueller, W.F.; Yu, C.H. Tennessee Univ., Knoxville, TN (United States). Dept. of Physics and Astronomy. [1992]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG05-87ER40361. From International conference on nuclear structure at high angular momentum; Ottawa (Canada); 18-21 May 1992. Order Number DE93014276. Source: OSTI; NTIS; INIS; GPO Dep.

The deformation-driving effects of intruder states are studied by analysis of various types of data on rotational bands in rare-earth deformed nuclei. The sensitivity of four measurables (bandhead energy, B(E2) value, neutron $i_{13/2}$ crossing frequency, and signature splitting) to increase deformation in an intruder band is shown. The analysis of signature splitting systematics is extended to know superdeformed bands.

25064 (CONF-9209342–1) **The Fermion Dynamical Symmetry Model and superdeformation.** Guidry, M.W. (Tennessee Univ., Knoxville, TN (United States). Dept. of Physics). Oak Ridge National Lab., TN (United States). 2 Oct 1992. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400 ;FG05-87ER40361. From International conference on nuclear structure and nuclear reactions at low and intermediate energies; Dubna (Russian Federation); 15-19 Sep 1992. Order Number DE93013273. Source: OSTI; NTIS; INIS; GPO Dep.

The Fermion Dynamical Symmetry Model is extended beyond a single major shell and used to construct a new model of superdeformation.

25065 (CONF-9211199–5) **Dynamical symmetry and shape coexistence.** Guidry, M. (Tennessee Univ., Knoxville, TN (United States). Dept. of Physics and Astronomy). Oak Ridge National Lab., TN (United States). [1992]. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From Symposium on nuclear physics of our times; Sanibel Island, FL (United States); 17-21 Nov 1992. Order Number DE93013211. Source: OSTI; NTIS; INIS; GPO Dep.

A general discussion is given of extending the Fermion Dynamical Symmetry Model to describe shape coexistence. The theory is applied to the description of superdeformation and normal deformations through alternative dynamical symmetries.

25066 (CONF-9211199–7) **Nuclear superdeformation.** Nazarewicz, W. (Oak Ridge National Lab., TN (United States)). Oak Ridge National Lab., TN (United States); Tennessee Univ., Knoxville, TN (United States). Dept. of Physics. [1992]. 19p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400 ;FG05-87ER40361 ;FG05-93ER40770. From Symposium on nuclear physics of our times; Sanibel Island, FL (United States); 17-21 Nov 1992. Order Number DE93012968. Source: OSTI; NTIS; INIS; GPO Dep.

In the year 1986 new types of exotic states, the so-called superdeformed states, were discovered in fast rotating heavy atomic nuclei. They are characterized by an unusually large distortion (comparable to that appearing in fissioning isomers) and occur at high angular momenta. A sizeable amount of high-spin data on superdeformed states makes it possible, for the first time, to test many fine details of the shell structure at very large elongations and very high angular momentum.

25067 (DOE/ER/40159–199) **The structure of nuclei far from stability: Progress report, May 15, 1992–May 14, 1993.** Zganjar, E.F. Louisiana State Univ., Baton Rouge, LA (United States). Dept. of Physics and Astronomy. 1993. 45p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG05-84ER40159. Order Number DE93013376. Source: OSTI; NTIS; INIS; GPO Dep.

Studies on nuclei near Z=82 contributed to the establishment of a new region of nuclear deformation and a new class of nuclear structure at closed shells. A important aspect of this work is the establishment of the connection between low-lying 0^+ states in even–even nuclei and the occurrence of shape coexistence in the odd-mass neighbors (E0 transitions in ^{185}Pt, shape coexistence in ^{184}Pt and ^{187}Au). A new type of picosecond lifetime measurement system capable of measuring the lifetime of states that decay only by internal conversion was developed and applied to the ^{186,188}Tl decay to determine the lifetime of the 0_2^+ and 2_2^+ deformed states in ^{186,188}Hg. A search for the population of superdeformed states in ^{192}Hg by the radioactive decay of ^{192}Tl was accomplished by using a prototype internal pair formation spectrometer.

25068 (EGG-M–92648) **The level at a few EV of excitation in ^{229}Th.** Reich, C.W.; Helmer, R.G. EG and G Idaho, Inc., Idaho Falls, ID (United States). [1992]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-76ID01570. (CONF-9211199–4: Symposium on nuclear physics of our times,

Sanibel Island, FL (United States), 17-21 Nov 1992). Order Number DE93010790. Source: OSTI; NTIS; INIS; GPO Dep.

Several years ago, we reported that there was an excited state of ^{229}Th that occurred within a few electron volts of the ground state. Since that time, we have carried out an extensive series of measurements in an effort to obtain a value, rather than merely a limit, for the excitation energy of this level. This study has now been completed. Analysis of these data, which is still in progress, indicates that this level energy is 4.5 eV, with an estimated uncertainty of 1 eV.

25069 (JINR-E-4-92-124) **Influence of giant angular resonances on the electromagnetic characteristics of low-lying states.** Mikhajlov, I.N.; Usmanov, P.N. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of Theoretical Physics. 1992. [26p.] Order Number DE93626797. Source: OSTI; NTIS (US Sales Only); INIS.

The two-rotor model with the Feshbach projection operator method is applied for investigating the properties of the positive parity low-lying collective states in the rare earth nuclei. The calculations of the energy spectra, E2-transition probability and magnetic propertiesd of the states of $\beta$$-and γ-bands tothe ground band are estimated. 26 refs.; 6 figs.; 8 tabs.

25070 (LBL–33903) **β^+ decay and cosmic-ray half-life of ^{54}Mn.** da Cruz, M.T.F. (Lawrence Berkeley Lab., CA (United States)); Norman, E.B.; Chan, Y.D.; Garcia, A.; Larimer, R.M.; Lesko, K.T.; Stokstad, R.G.; Wietfeldt, F.E.; Hindi, M.M.; Zlimen, I. Lawrence Berkeley Lab., CA (United States). 29 Mar 1993. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098 ;FG05-87ER40314. (CONF-930779–13: International cosmic-ray conference, Calgary (Canada), 19-20 Jul 1993). Order Number DE93013913. Source: OSTI; NTIS; INIS; GPO Dep.

We performed a search for the β^+ branch of ^{54}Mn decay. As a cosmic ray, ^{54}Mn, deprived of its atomic electrons, can decay only via β^+ and β^- decay, with a half-life of the order of 10^6 yr. This turns ^{54} Mn into a suitable cosmic chronometer for the study of cosmic-ray confinement times. We searched for coincident back-to-back 511-keV γ-rays using two germanium detectors inside a NaI(Tl) annulus. An upper limit of 2×10^{-8} was found for the β^+ decay branch, corresponding to a lower limit of 13.7 for the log ft value.

25071 (ORNL/FTR–4219) **[Travel to France to attend and present two invited talks at the international workshop on the physics techniques of secondary nuclear beams at Dourdan, France]: Foreign trip report, March 21–26, 1992.** Trivelpiece, A.W. Oak Ridge National Lab., TN (United States). 6 Apr 1992. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93010573. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The primary purpose of this foreign travel was to attend the International Workshop on the Physics Techniques of Secondary Nuclear Beams and to present two invited talks. The scientific and technical portions of the program are summarized as is the organization of the European effort to construct radioactive beam facilities for nuclear structure and astrophysics. Another topic of discussion was the European effort in developing advanced gamma-ray detection facilities. The traveler also summarizes this effort.

6632 Radioactivity and Electromagnetic Transitions (Excluding Fission)

Refer also to citation(s) 24957, 25053, 25067, 25139

25072 (CONF-9210249–10) **Influence of dissipation of the population and decay of compound nuclei.** Thoennessen, M. (Michigan State Univ., East Lansing, MI (United States)); Beene, J.R. Oak Ridge National Lab., TN (United States). [1992]. 15p. Sponsored by USDOE, Washington, DC (United States); National Science Foundation, Washington, DC (United States). DOE Contract AC05-84OR21400. Grant: PHY-89-13815. From 1992 international symposium on rapidly rotating nuclei; Tokyo (Japan); 26-30 Oct 1992. Order Number DE93009668. Source: OSTI; NTIS; INIS; GPO Dep.

The importance of nuclear dissipative effects in the formation and decay of compound nuclei is investigated with the γ-ray decay of the giant dipole resonance built on highly excited states. These studies show evidence for long formation times ($\sim 10^{-20}$s) in heavy, almost symmetric systems. Enhanced γ-ray emission is observed in the decay of fissile nuclei because of the dynamical hindrance of fission. This effect allows the study of hot nuclei prior to fission and it also influences the spin distribution leading to evaporation residues.

25073 (DOE/ER/40427–21-N92) **Double beta decay: Comparison of theory to experiment.** Haxton, W.C. Washington Univ., Seattle, WA (United States). [1992]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG06-88ER40427 ;FG06-90ER40561. (CONF-9206227–7: 15. international conference on neutrino physics, Granada (Spain), 7-13 Jun 1992). Order Number DE93010201. Source: OSTI; NTIS; INIS; GPO Dep.

I review $\beta\beta$ decay in the standard model and as a test of Majorana neutrino masses and right-handed couplings. A summary is given of some of the nuclear physics issues involved in evaluating 2 ν and 0ν matrix elements. Dirac and pseudoDirac limits are discussed to illustrate how quantities constrained on 0ν $\beta\beta$ decay depend on the parameters of the mass matrix. Implications of 0ν $\beta\beta$ decay for models with 17 keV neutrinos, for models with massive Majorana neutrinos, and for Majorons are discussed. It is argued that a recent remeasurement of the total $\beta\beta$ decay rate of ^{128}Te is important in constraining (nonstandard) Majoron models.

25074 (DOE/FTR–93013556) **Travel to Germany to attend the 6th international conference on nuclei far from stability and 9th international conference on atomic masses and fundamental constants: Foreign trip report, July 18–25, 1992.** Mantica, P.F. Jr.; Carter, H.K. Oak Ridge Inst. for Science and Education, TN (United States). 9 Sep 1992. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-76OR00033. Order Number DE93013556. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The purpose of this foreign travel was to attend and to present posters covering recent UNISOR work at the combined conferences: "6th International Conference on Nuclei far from Stability and 9th International Conference on Atomic Masses and Fundamental Constants". The scientific and technical points of particular interest to UNISOR research as determined through the presentations and private discussions are briefly summarized.

25075 (IPNO-DRE–92-31) **Transfer results for odd-odd ^{196}Au and the extended supersymmetry.** Rotbard, G. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire); Berrier, G.; Vergnes, M.; Fortier, S.; Kalifa, J.; Maison, J.M.; Rosier, L.; Vernotte, J.; Van Isacker, P.; Jolie, J. Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire. 1992. [25p.] Order Number DE93626833. Source: OSTI; NTIS (US Sales Only); INIS.

^{196} Au has been studied with an energy resolution of 12 keV via the ^{197} Au(p,d)^{196} Au reaction, using a 25 MeV proton beam from the Orsay MP tandem and the split pole spectrometer. The angular distributions, measured at 12 angles, permit to clearly characterize the l = 1.3 and 6 transfers. Data concerning the energies, I values and absolute spectroscopic factors have been obtained; a comparison is made, for negative parity levels, between these results and theoretical energies, spins and strengths calculated in the framework of the extended supersymmetry. A preliminary level scheme is proposed for ^{196} Au and a few tentative spin attributions are suggested.

25076 (IPNO-DRE–92-34) **Decay properties of exotic N $\simeq$ 28 S and Cl nuclei and the ^{48}Ca/^{46}Ca abundance ratio.** Sorlin, O. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire); Guillemaud-Mueller, D.; Mueller, A.C.; Borrel, V.; Dogny, S.; Pougheon, F.; Kratz, K.L.; Gabelmann, H.; Pfeiffer, B.; Woehr, A.; Ziegert, W.; Penionzhkevich, Y.E.; Lukyanov, S.MParis-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire. 1992. [25p.] Order Number DE93626834. Source: OSTI; NTIS (US Sales Only); INIS.

Beta-decay half-lives and β-delayed neutron-emission probabilities of the very neutron-rich nuclei ^{44}S and $^{45-47}$ Cl have been measured. These isotopes, which lie at or close to the N=28 magic shell were produced in interactions of a 60 MeV/u ^{48} Ca beam from

GANIL (Grand Accelerateur National d'Ions Lourds) with a ^{64} Ni target and were separated by the doubly achromatic spectrometer LISE (Ligne d'Ions Super Epluches). Their decay was studied by a β-n time correlation measurement. The results are compared to recent model predictions and indicate a rapid weakening of the N=28 shell effect below $^{48}_{20}Ca_{28}$. The nuclear structure effects reflected in the decay properties of the exotic S and Cl isotopes may be the clue for the astrophysical understanding of the unusual ^{48} Ca/^{46}Ca abundance ratio measured in the solar system as well as the Ca-Ti-Cr anomalies observed in EK-inclusions of the Allende meteorite.

25077 (IPNO-T–92-02) **Measurement of beta decay periods for Fe-Ni neutrons rich isotopes.** Czajkowski, S. (Paris-7 Univ., 75 (France)). Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire. 27 May 1992. [116p.] (In French). Order Number DE93626835. Source: OSTI; NTIS (US Sales Only); INIS.

Thermal fission of ^{239} Pu was used to produce ^{68,69} Co and ^{68} Fe isotopes, the lightest ones ever observed in thermal fission, at the ILL high-flux reactor, in Grenoble. Separated with the Lohengrin recoil spectrometer, then identified by means of a Δ E-E ionization chamber, fragments were implanted in a set of Si-detectors, where β-particles were detected too. The fission yields were determined, and the beta-decay half-lives were extracted from delayed coincidence analysis between ion implantation and the subsequent beta detection: They were found to be 0.27 ± 0.05s, 0.18 ± 0.10s, and 0.10 ± 0.06s respectively for ^{69} Co, ^{68} Co, and ^{68} Fe. This method was adapted to a new experimental configuration: ^{65} Fe isotopes were produced from ^{86} Kr projectile fragmentation at 500 MeV/u on a Be target. Selected ions were separated with the fragment separator FRS at GSI (Darmstadt), tuned in the monoenergetic mode. Fragments were identified by ΔE-ToF, slowed down, and then implanted in two rows of PIN-diodes that provided an additional range selection. The half-life were determined from the analysis of the decay chain Fe-Co-Ni: it was found 0.4 ± 0.2s. Production rates obtained with the two methods are compared at the end of this work.

25078 (KFKI–1992-15/A) **Measurable distributions of unpolarized neutron decay.** Glueck, F. (Hungarian Academy of Sciences, Budapest (Hungary). Central Research Inst. for Physics). Hungarian Academy of Sciences, Budapest (Hungary). Central Research Inst. for Physics. May 1992. [23p.] Order Number DE93626836. Source: OSTI; NTIS (US Sales Only); INIS.

Several two- and one-dimensional distributions of unpolarized free neutron decay are calculated. The results of the order-α model independent radiative correction calculations are tabulated numerically. With these corrections the theoretical distributions become precise enough to make possible the determination of the ratio of the axial-vector to the vector weak coupling constants to a precision of $\approx$0.001. (author) 39 refs.; 7 tabs.

25079 (LBL–33959) **β^+ decay and cosmic-ray half-lives of ^{143}Pm and ^{144}Pm.** Hindi, M.M. (Tennessee Technological Univ., Cookeville, TN (United States). Dept. of Physics); da Cruz, M.T.F.; Larimer, R.M.; Lesko, K.T.; Norman, E.B.; Sur, B.; Champagne, A.E. Lawrence Berkeley Lab., CA (United States). 12 Apr 1993. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098 ;FG05-87ER40314. (CONF-930779–12: International cosmic-ray conference; Calgary (Canada), 19-20 Jul 1993). Order Number DE93013819. Source: OSTI; NTIS; GPO Dep.

The positron decay partial half-lives of ^{143}Pm and ^{144}Pm are needed to assess the viability of elemental Pm as a cosmic-ray clock. We have conducted experiments to measure the β^+ branches of these isotopes; we find β^+ branches of these isotopes; we find β^+ branches of $<5.7\times10^{-8}$ for ^{143}Pm and $<8\times10^{-7}$ for ^{144}Pm. Through these branches are a factor of 20 lower than the previous experimental limits, the resulting partial half-lives are still too uncertain to permit any firm conclusions.

25080 (ORNL/TM–12358) **Analysis of Fe(n,xγ) cross sections using the TNG nuclear reaction model code.** McCollam, K.J. Oak Ridge National Lab., TN (United States). Apr 1993. 27p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400 ;AC05-76OR00033. Order Number DE93013474. Source: OSTI; NTIS; INIS; GPO Dep.

Theoretical gamma ray cross sections have been calculated using a nuclear reaction model code. These are compared to experimental gamma ray production cross sections obtained from neutron interactions with ^{56}Fe at incident neutron energies of 1 to 40 MeV. The optical model and nuclear level density parameters in the code have been varied to affect a close agreement between calculations and the data. Present analyses, which focus on incident neutron energies between 17 and 40 MeV, display somewhat better agreement than those previously reported.

6633 Nuclear Reactions and Scattering, General

25081 (DOE/ER/40437–4) **Pion correlations and calorimeter design for high energy heavy ion collisions: Progress in research, 1992.** Wolf, K.L. Texas A and M Univ., College Station, TX (United States). Cyclotron Inst. 1992. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG05-88ER40437. Order Number DE93013861. Source: OSTI; NTIS; INIS; GPO Dep.

The 1992 research program is reported under the following topics: The EOS time projection chamber program; the NA44 experiment at CERN; sampling calorimeter construction.

25082 (DOE/ER/40530–8) **Stochastic two-fluid model for relativistic heavy-ion collisions.** Ayik, S. (Tennessee Technological Univ., Cookeville, TN (United States)); Ivanov, Y.B.; Russkikh, V.N.; Noerenberg, W. Tennessee Technological Univ., Cookeville, TN (United States). [1993]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG05-89ER40530. (CONF-930197–2: 9. winter workshop on nuclear dynamics, Key West, FL (United States), 30 Jan - 6 feb 1993). Order Number DE93011272. Source: OSTI; NTIS; INIS; GPO Dep.

A reduction of the relativistic Boltzmann-Langevin Equation (BLE), to a stochastic two-fluid model is presented, and transport coefficients associated with fluid dynamical variables are extracted. The approach is applied to investigate equilibration in a counter-streaming nuclear system.

25083 (ECN-RX–92-066) **Quantummechanical multi-step direct models for nuclear data applications.** Koning, A.J. (Netherlands Energy Research Foundation (ECN), Petten (Netherlands)). Netherlands Energy Research Foundation (ECN), Petten (Netherlands). Oct 1992. [8p.] (CONF-921046–: Symposium on nuclear data evaluation methodology, Upton, NY (United States), 12-16 Oct 1992). Order Number DE93626845. Source: OSTI; NTIS; INIS.

Various multi-step direct models have been derived and compared on a theoretical level. Subsequently, these models have been implemented in the computer code system KAPSIES, enabling a consistent comparison on the basis of the same set of nuclear parameters and same set of numerical techniques. Continuum cross sections in the energy region between 10 and several hundreds of MeV have successfully been analysed. Both angular distributions and energy spectra can be predicted in an essentially parameter-free manner. It is demonstrated that the quantum-mechanical MSD models (in particular the FKK model) give an improved prediction of pre-equilibrium angular distributions as compared to the experiment-based systematics of Kalbach. This makes KAPSIES a reliable tool for nuclear data applications in the aforementioned energy region. (author). 10 refs., 2 figs.

25084 (KFKI–1992-23/G) **Objective judgement by Kalman filtering in the generalized Landsbergian scheme.** Lukacs, B. (Hungarian Academy of Sciences, Budapest (Hungary). Central Research Inst. for Physics); Racz, A. Hungarian Academy of Sciences, Budapest (Hungary). Central Research Inst. for Physics. Aug 1992. [17p.] Order Number DE93626846. Source: OSTI; NTIS (US Sales Only); INIS.

A method is suggested to check if a non-equilibrium thermodynamic description of a system is complete. Exploring Landsberg's idea of the role of third person, a scheme is proposed for treating non-equilibrium systems as well. In order to suppress irrelevant information carried by measurement noise or for very fast phenomena, Kalman filter can act as the objective spectator. The idea is illustrated via a thermodynamic model of non-relativistic heavy ion collisions. (author) 12 refs.; 3 figs.

25085 (ORNL/FTR–4236) **[Travel to France and Austria to visit the IAEA Nuclear Data Section]: Foreign trip report, April 5–17, 1992.** White, J.E. Oak Ridge National Lab., TN (United States). 24 Apr 1992. 33p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93011111. Source: OSTI; NTIS (US Sales Only); GPO Dep.

New versions of EFF, ENDF/B, FENDF, and JEF evaluated nuclear data files have recently been released for benchmarking purposes. All data files have adopted the ENDF-6 format for describing the physics which includes new representations of data to allow more recent nuclear theory to be used in evaluations and improved treatment in applications. NJOY has been adopted by many laboratories and projects worldwide for processing ENDF-6 format data files. During the past several years, large segments of NJOY were rewritten with some adverse effects on the continuity of both national and international programs. The primary aim of the seminar was to bring together authors and users of the NJOY code system and evaluated data files to present the most recent code developments, discuss performance, and exchange know-how and methods for efficient processing of evaluations. The seminar was suggested and encouraged by the OECD NEA Data Bank Management Committee and the JEF Scientific Coordination Group. The traveler is actively involved in several multigroup cross section development projects using NJOY91 at ORNL.

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Refer also to citation(s) 24980, 25020, 25021, 25032, 25045, 25047, 25062, 25080, 25084, 25457, 25461, 25462, 25464, 25465, 25470

25086 (ANL/EP/CP–79504) **Integral measurement of ^{9}Be(n,2n)^{8}Be in the ^{9}Be(d, n) neutron spectrum.** Meadows, J.W. (Argonne National Lab., IL (United States)); Smith, D.L.; Greenwood, L.R.; Kneff, D.W.; Oliver, B.M. Argonne National Lab., IL (United States). [1993]. 19p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-9305125–1: International workshop on nuclear data for fusion reactor technology, San Diego, CA (United States), 3-6 May 1993). Order Number DE93012943. Source: OSTI; NTIS; INIS; GPO Dep.

^{4}He production has been measured, by an isotopic dilution mass spectrometry method, for the irradiation of Be-metal samples by fast neutrons from the ^{9}Be(d,n) source reaction, corresponding to 7-MeV deuterons incident on a thick Be-metal target. The ^{58}Ni(n,p)$^{58g+m}$Co dosimetry reaction was employed as a reference standard for measurement of the neutron flux. The integral cross section for the ^{9}Be(n,2n)^{8}Be(2^{2}He) reaction was deduced by applying a correction of 9.4% to account for the ^{9}Be(n,α)^{6}He reaction contribution to the total ^{4}He yield from neutrons on Be. The experimental integral reaction cross-section ratio of ^{9}Be(n,2n)2^{4}He to ^{58}Ni(n,p)$^{58g+m}$Co in this spectrum was found to be 1.217, with an error of $\sim$ 3.5%. This can be compared to the corresponding calculated ratio of 1.161, based on an average of results obtained by considering four distinct representations of the ^{9}Be(d,n) neutron spectrum and ENDF/B-VI values for the reaction cross sections. The scatter of the calculated results amounts to $\sim$ 0.3%. It is small because the shapes of the response functions, $R(E)=\phi(E)\sigma(E)$, for these two reactions in this neutron spectrum are very similar. The observed C/E is 0.954. This is excellent agreement, considering the various uncertainties involved, including those for the differential cross sections from ENDF/B-VI.This particular integral measurement is sensitive to the differential reaction cross section in the range 3–6 MeV. Therefore, the results of the present investigation indicate that ENDF/B-VI represents the ^{9}Be(n,2n)2^{4}He reaction differential cross section quite well in this energy range.

25087 (BNL–48587) **Global transverse and forward energy measurements for Si+A and Au+A at the AGS.** Moskowitz, B. E802/866 Collaboration. Brookhaven National Lab., Upton, NY (United States). [1993]. 9p. Sponsored by USDOE, Washington, DC (United States); National Aeronautics and Space Administration, Washington, DC (United States); US-Japan High Energy Physics Collaboration. DOE Contract AC02-76CH00016. (CONF-930173–3: HIPAGS meeting, Cambridge, MA (United States), 14-17 Jan 1993). Order Number DE93010934. Source: OSTI; NTIS; INIS; GPO Dep.

The global transverse and forward energy from Si+Al,Au at 14.6A GeV/c and Au+Al,Au, at 11.6A GeV/c have been measured using the E802 lead-glass and ZCAL. Preliminary $d\sigma/dE_T$, $dE_T/d\eta$ and $d\sigma dT_{ZCAL}$ spectra are presented, and the shapes of the spectra from different systems are compared. The transverse and forward energies in Au+Au are observed to be anticorrelated in a manner that is reproduced by the cascade model ARC but not by the essentially geometric model Fritiof.

25088 (BNL–48588) **Baryon spectra in Au + Au collisions: Preliminary results from E-866.** Gonin, M. The E-802/E-866 Collaboration. Brookhaven National Lab., Upton, NY (United States). [1992]. 7p. Sponsored by USDOE, Washington, DC (United States); National Aeronautics and Space Administration, Washington, DC (United States); US-Japan High Energy Physics Collaboration. DOE Contract AC02-76CH00016 ;W-31109-ENG-38 ;AC03-76SF00098 ;W-7405-ENG-48. (CONF-921122–50: Meeting of the Division of Particles and Fields of the American Physical Society, Batavia, IL (United States), 10-14 Nov 1992). Order Number DE93010878. Source: OSTI; NTIS; INIS; GPO Dep.

Measurements are presented of single particle spectra from Au targets using the recently commissioned Au-beam at 11.6 GeV/c per nucleon from the BNL Tandem-Booster-AGS accelerator facilities. Protons and deuterons were detected with the measuring the 25msr E-802 spectrometer. Collision centrality was determined by measuring the forward energy in a calorimeter subtending a 1.2° cone about 0°. Some comparisons with the cascade code ARC have been made.

25089 (BNL–48594) **Production of strange clusters in relativistic heavy ion collisions.** Dover, C.B.; Baltz, A.J.; Pang, Yang; Schlagel, T.J.; Kahana, S.H. Brookhaven National Lab., Upton, NY (United States). Feb 1993. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-930173–5: HIPAGS meeting, Cambridge, MA (United States), 14-17 Jan 1993). Order Number DE93010876. Source: OSTI; NTIS; INIS; GPO Dep.

We address a number of issues related to the production of strangeness in high energy heavy ion collisions, including the possibility that stable states of multi-strange hyperonic or quark matter might exist, and the prospects that such objects may be created and detected in the laboratory. We make use of events generated by the cascade code ARC to estimate the rapidity distribution dN/dy of strange clusters produced in Si+Au and Au+Au collisions at AGS energies. These calculations are performed in a simple coalescence model, which yields a consistent description of the strange cluster (d, ^{3}HE, ^{3}H, ^{4}He) production at these energies. If a doubly strange, weakly bound $\Lambda\Lambda$ dibaryon exists, we find that it is produced rather copiously in Au+Au collisions, with dN/dy $\sim$0.1 at raid-rapidity. If one adds another non-strange or strange baryon to a cluster, the production rate decreases by roughly one or two orders of magnitude, respectively. For instance, we predict that the hypernucleus $_{\Lambda\Lambda}{}^{6}$He should have dN/dy $\sim 5 \times 10^{-6}$ for Au+Au central collisions. It should be possible to measure the successive $\Lambda \rightarrow p\pi-$ weak decays of this object. We comment on the possibility that conventional multi-strange hypernuclei may serve as "doorway states" for the production of stable configurations of strange quark matter, if such states exist.

25090 (BNL–48634) **Meson production from the E-802 and E-866 experiments at the AGS.** Gonin, M. E-802 Collaboration. Brookhaven National Lab., Upton, NY (United States). [1993]. 12p. Sponsored by USDOE, Washington, DC (United States); National Aeronautics and Space Administration, Washington, DC (United States); US-Japan High Energy Physics Collaboration. DOE Contract AC02-76CH00016 ;W-31109-ENG-38 ;AC03-76SF00098 ;W-7405-ENG-48. (CONF-930173–4: HIPAGS meeting, Cambridge, MA (United States), 14-17 Jan 1993). Order Number DE93010875. Source: OSTI; NTIS; INIS; GPO Dep.

Preliminary results from E-802 (Si-beam) and B-866 (Au-beam) are presented for central collisions. Meson production (π's and K's) in heavy ion collisions are discussed from light systems (A = 55) to

heavy systems (A = 394). Comparisons with predictions of the cascade code ARC are carried out. The balance of energy and momentum is considered for the Au+Au data.

25091 (BNL–48649) **Neutral strange particle production at the AGS.** Saulys, A.C. For the E810 Collaboration. Brookhaven National Lab., Upton, NY (United States). 11 Feb 1993. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016 ;FG02-91ER40645 ;FG02-88ER40413 ;FG05-87ER40309. (CONF-930173–9: HIPAGS meeting, Cambridge, MA (United States), 14-17 Jan 1993). Order Number DE93014044. Source: OSTI; NTIS; INIS; GPO Dep.

We present the results of Λ and K_s^o production from Si and Pb targets with 14.6×Λ Gev/c Si beams. The measured rapidity distributions and the transverse mass exponential slopes are presented and compared with models.

25092 (CONF-9211199–6) **Theoretical study of fission dynamics with muons.** Oberacker, V.E. (Vanderbilt Univ., Nashville, TN (United States). Dept. of Physics and Astronomy); Umar, A.S.; Wells, J.C.; Bottcher, C.; Strayer, M.R.; Maruhn, J.A. Oak Ridge National Lab., TN (United States). [1992]. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From Symposium on nuclear physics of our times; Sanibel Island, FL (United States); 17-21 Nov 1992. Order Number DE93012761. Source: OSTI; NTIS; INIS; GPO Dep.

Following muon capture by actinide atoms, some of the inner shell muonic transitions proceed by inverse internal conversion, i.e. the excitation energy of the muonic atom is transferred to the nucleus. In particular, the muonic E2:(3d→1s) transition energy is close to the peak of the isoscalar giant quadrupole resonance in actinide nuclei which exhibits a large fission width. Prompt fission in the presence of a bound muon allows us to study the dynamics of large-amplitude collective motion. We solve the time-dependent Dirac equation for the muonic spinor wave function in the Coulomb field of the fissioning nucleus on a 3-dimensional lattice and demonstrate that the muon attachment probability to the light fission fragment is a measure of the nuclear energy dissipation between the outer fission barrier and the scission point.

25093 (CONF-930197–3) **Formation and decay of toroidal and bubble nuclei and the nuclear equation of state.** Xu, H.M. (Texas A and M Univ., College Station, TX (United States). Cyclotron Inst.); Gagliardi, C.A.; Natowitz, J.B.; Tribble, R.E.; Wong, C.Y.; Lynch, W.G. Oak Ridge National Lab., TN (United States). [1993]. 7p. Sponsored by USDOE, Washington, DC (United States); National Science Foundation, Washington, DC (United States); Welch (Robert A.) Foundation, Houston, TX (United States). DOE Contract AC05-84OR21400 ;FG05-86ER40256. Grant PHY-89-13815. From 9. winter workshop on nuclear dynamics; Key West, FL (United States); 30 Jan - 6 feb 1993. Order Number DE93011848. Source: OSTI; NTIS; INIS; GPO Dep.

Multifragmentation, following the formation of toroidal and bubble nuclei, is observed with an improved Boltzmann-Uehling-Uhlenbeck (BUU) model for central ^{92}Mo + ^{92}Mo collisions. Guided by our BUU model, we propose two signatures: (1) because of the geometries of bubbles and toroids and because of the cold breakup at low temperatures, we predict enhanced cross sections for fragments with nearly-equal masses at small center-of-mass energies. (2) the coplanarity of these nearly-equal fragments could carry important information concerning the geometry of the sources. This in turn, could provide information about the stiffness of the equation of state.

25094 (CONF-9301109–1) **Measurements of transverse energy and forward energy in high-energy nuclear collisions.** Sorensen, S.P. (Tennessee Univ., Knoxville, TN (United States). Dept. of Physics). Oak Ridge National Lab., TN (United States). [1993]. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 2. international conference on physics and astrophysics of quark-gluon plasma; Calcutta (India); 19-23 Jan 1993. Order Number DE93012755. Source: OSTI; NTIS; INIS; GPO Dep.

The experimental data on forward energy and transverse energy production in high energy nuclear collisions at the AGS and SPS accelerators are reviewed.

25095 (CRN–92-32) **Putting in evidence the asymmetric fission in the desexcitation process of ^{47}V nuclei.** Djerroud, B. (Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires). Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires. Jun 1992. [180p.] (In French). Order Number DE93626932. Source: OSTI; NTIS (US Sales Only); INIS.

The fusion-fission, which reflects the instability of the nuclei against the deformation and leads to a binary break up into nearly equal mass nuclei, have been considered as a general feature of the heavy ions (A>80). For lighter systems the fission decay of the compound nucleus is predicted by the rotating liquid drop model to be minor process and the fully-damped products observed in reactions between light heavy ions (A<43) have been explained by an orbiting process for which the equilibration of the dinuclear system is not fully accomplished. In the present work, the properties of the fully-damped binary fragments have been investigated in the ^{35} Cl+^{12} C, ^{31} P+^{16} O and ^{23} Na+^{24} Mg reactions used in order to populate the ^{47} V system at two excitation energies E = 59 and 64 MeV. This study shows that these fragments are the result of the emission from a source and their elemental distributions are asymmetric independently to the entrance channel asymmetry. The absence of entrance channel effect is a signature of the asymmetric fission process of the ^{47} V nucleus. The comparison of the experimental observations to the statistical model shows that the fission barriers in this mass region are lower than those predicted by the rotating liquid drop model and the need of introducing their angular momentum and mass asymmetry dependence is clearly shown. In conclusion, it is well established that the evidence of the asymmetric fission break up into the desexcitation process of the ^{47} V nucleus should be taken into account in the statistical calculations describing the complete fusion of light heavy ions.

25096 (CRN–92-51) **Angular momentum distributions for ^{16}O + ^{144}Nd.** Duchene, G. (Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires); Romain, P.; Beck, F.A.; Benet, P.; Disdier, D.; Haas, B.; Lott, B.; Rauch, V.; Scheibling, F.; Vivien, J.P.; Basu, S.K.; Bozek, E.; Zuber, K.; Di Gregorio, D.E. Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires. 1992. [45p.] Order Number DE93626899. Source: OSTI; NTIS (US Sales Only); INIS.

Fusion cross sections have been measured for the system ^{16} O + ^{144} Nd at bombarding energies in the range 67 MeV $\leq E_{lab} \leq$ 90 MeV by detecting directly evaporation residues in Si detectors and in the range 60 MeV $\leq E_{lab} \leq$ 75 MeV by off-line detection of the K X-rays emitted by the radioactive evaporation residues and daughters. In order to obtain the spin distributions in the compound system gamma-ray multiplicity distributions for the most important neutron evaporation channels were also measured using a 4π - BaF_2 array, in conjunction with Ge detectors. Results are compared with calculations based on models that consider fluctuations in barrier height due to ground state zero point vibrations as well as couplings to various inelastic and transfer channels.

25097 (DOE/ER/40293–7) **Nuclear structure studies via neutron interactions: Progress report, 1 July 1992–30 June 1993.** Carlton, R.F. Middle Tennessee State Univ., Murfreesboro, TN (United States). Dept. of Chemistry and Physics. Mar 1993. 22p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG05-86ER40293. Order Number DE93013868. Source: OSTI; NTIS; INIS; GPO Dep.

Comparison has been made between the empirical integrated strengths and external R-functions and the predictions of a dispersive optical model for the n-^{208}Pb system, for partial waves through $f_{7/2}$. Parameters of a constant geometry model give a fair representation of the experimental results. A hint of the need for a parity dependence in one of the model parameters is seen in the two data and in thetotal cross section in the low-energy region. Other research performed consisted of: (1) refinement of the resonance analysis of the n-^{208}Pb system, resulting in more definitive J^{π} assignments and external R-functions consistent over the neutron energy range [80–1760 keV]; (2) background correction and processing of n-^{86}Sr differential scattering cross section data for use with total cross section data for R-matrix analysis (3) measurement of the n-^{90}Zr differential scattering cross section at the 200-m flight path of the ORELA.

25098 (DOE/ER/40321–8) **Mass and charge distributions in chlorine-induced nuclear reactions.** Marchetti, A.A. Maryland Univ., College Park, MD (United States). Dept. of Chemistry and Biochemistry. 1991. 227p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG05-87ER40321. Order Number DE93013383. Source: OSTI; NTIS; INIS; GPO Dep.

Projectile-like fragments were detected and characterized in terms of A, Z, and energy for the reactions ^{37}Cl on ^{40}Ca and ^{209}Bi at E/A = 7.3 MeV, and ^{35}Cl, on ^{209}Bi at E/A = 15 MeV, at angles close to the grazing angle. Mass and charge distributions were generated in the N-Z plane as a function of energy loss, and have been parameterized in terms of their centroids, variances, and coefficients of correlation. Due to experimental problems, the mass resolution corresponding to the ^{31}Cl on ^{209}Bi reaction was very poor. This prompted the study and application of a deconvolution technique for peak enhancement. The drifts of the charge and mass centroids for the system ^{37}Cl on ^{40}Ca are consistent with a process of mass and charge equilibration mediated by nucleon exchange between the two partners, followed by evaporation. The asymmetric systems show a strong drift towards larger asymmetry, with the production of neutron-rich nuclei. It was concluded that this is indicative of a net transfer of protons from the light to the heavy partner, and a net flow of neutrons in the opposite direction. The variances for all systems increase with energy loss, as it would be expected from a nucleon exchange mechanism; however, the variances for the reaction ^{37}Cl on ^{40}Ca are higher than those expected from that mechanism. The coefficients of correlation indicate that the transfer of nucleons between projectile and target is correlated. The results were compared to the predictions of two current models based on a stochastic nucleon exchange mechanism. In general, the comparisons between experimental and predicted variances support this mechanism; however, the need for more realistic driving forces in the model calculations is indicated by the disagreement between predicted and experimental centroids.

25099 (DOE/ER/40321–10) **The decay of hot nuclei formed in La-induced reactions at E/A=45 MeV.** Libby, B. Maryland Univ., College Park, MD (United States). Dept. of Chemistry and Biochemistry. 1993. 307p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG05-87ER40321. Order Number DE93013384. Source: OSTI; NTIS; INIS; GPO Dep.

The decay of hot nuclei formed in the reactions ^{139}La + ^{27}Al, ^{51}V, ^{nat}Cu, and ^{139}La were studied by the coincident detection of up to four complex fragments (Z > 3) emitted in these reactions. Fragments were characterized as to their atomic number, energy and in- and out-of-plane angles. The probability of the decay by an event of a given complex fragment multiplicity as a function of excitation energy per nucleon of the source is nearly independent of the system studied. Additionally, there is no large increase in the proportion of multiple fragment events as the excitation energy of the source increases past 5 MeV/nucleon. This is at odds with many prompt multifragmentation models of nuclear decay. The reactions ^{139}La + ^{27}Al, ^{51}V, ^{nat}Cu were also studied by combining a dynamical model calculation that simulates the early stages of nuclear reactions with a statistical model calculation for the latter stages of the reactions. For the reaction ^{139}La + ^{27}Al, these calculations reproduced many of the experimental features, but other features were not reproduced. For the reaction ^{139}La + ^{51}V, the calculation failed to reproduce somewhat more of the experimental features. The calculation failed to reproduce any of the experimental features of the reaction ^{139}La + ^{nat}Cu, with the exception of the source velocity distributions.

25100 (DOE/ER/40321–11) **Mass and charge distributions in iron-induced reactions and excitation energy division between the fragments of the 672-MeV ^{56}Fe + ^{165}Ho reaction.** Madani, H. Maryland Univ., College Park, MD (United States). Dept. of Chemistry. 1993. 219p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG05-87ER40321. Order Number DE93013385. Source: OSTI; NTIS; INIS; GPO Dep.

The projectile-like and target-like fragments produced by the 12-MeV/nucleon ^{56}Fe + ^{165}Ho reaction were detected in coincidence. The measured parameters were the mass, charge, kinetic energy scattering angle of the projectile-like fragments, and the scattering angle of the target-like fragments. The mass and charge distributions of the projectile-like fragments were generated as a function of energy loss, and characterized by their centroids, variances, and correlation coefficients. The neutron drift of the measured projectile-like products is mostly due to evaporative processes, while the charge drift is a result of a net transfer of protons from the projectile-like fragment to the target-like fragment. The result is a weak drift of the system towards mass asymmetry. The predictions of two nucleon exchange models are compared to the experimental results of the 672-MeV ^{56}Fe + ^{165}Ho reaction and other Fe-induced reactions. The fairly good agreement between the experimental and theoretical variances verifies the prevalence of a nucleon exchange mechanism in these reactions. The information from the coincidence measurement and two-body kinematics are used to reconstruct the pre-evaporation masses of the projectile-like and target-like fragments of the reaction. Statistical evaporation calculations are used to translate these masses into excitation energies of the primary fragments. The ratio of excitation energy stored in the projectile-Mm fragment decreases with increasing energy loss, in qualitative agreement with previous measurements; however, higher ratios are observed for the 672-MeV ^{56}Fe on ^{165}Ho system.

25101 (DOE/ER/40561–080) **Nuclear astrophysics.** Haxton, W.C. Washington Univ., Seattle, WA (United States). [1992]. 6p. Sponsored by USDOE, Washington, DC (United States); National Aeronautics and Space Administration, Washington, DC (United States). DOE Contract FG06-90ER40561. Grant NAGW 2523. (CONF-920708–7: 2. international nuclear physics conference, Wiesbaden (Germany), 26 Jul - 1 aug 1992). Order Number DE93010569. Source: OSTI; NTIS; INIS; GPO Dep.

The problem of core-collapse supernovae is used to illustrate the many connections between nuclear astrophysics and the problems nuclear physicists study in terrestrial laboratories. Efforts to better understand the collapse and mantle ejection are also motivated by a variety of interdisciplinary issues in nuclear, particle, and astrophysics, including galactic chemical evolution, neutrino masses and mixing, and stellar cooling by the emission of new particles. The current status of theory and observations is summarized.

25102 (DOE/ER/40637–6) **[Relativistic heavy-ion collisions]: Annual report.** Hwa, R.C. Oregon Univ., Eugene, OR (United States). [1993]. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG06-91ER40637. Order Number DE93014844. Source: OSTI; NTIS; INIS; GPO Dep.

This report discusses the following topics: quark-hadron phase transition; hadron production without phase transition; fractal structure in multiparticle production; and j/psi suppression in pA collisions. (LIP)

25103 (ECN-RX–92-064) **Status of statistical model capture calculations.** Kopecky, J. (Netherlands Energy Research Foundation (ECN), Petten (Netherlands)); Uhl, M. Netherlands Energy Research Foundation (ECN), Petten (Netherlands). Oct 1992. [8p.] (CONF-921046–: Symposium on nuclear data evaluation methodology, Upton, NY (United States), 12-16 Oct 1992). Order Number DE93626881. Source: OSTI; NTIS; INIS.

The most important input parameters in statistical model neutron capture calculations are γ-ray strength functions and level densities. Several models have been considered for these quantities and their influence on the calculated total radiative width, capture cross sections and γ-ray spectra was studied. About 70 targets ($90<A<250$) have been used in these calculations with the emphasis on the behaviour of targets from the deformed region. (author). 25 refs., 3 figs.

25104 (GANIL-P–93-03) **Inclusive excitation-energy distributions of hot nuclei from 44 MeV/nucleon Ar- and 32 MeV/nucleon Kr-induced reactions.** Duchene, G. (Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires); Lott, B.; Frehaut, J.; Patin, Y.; Pranal, Y.; Uzureau, J.L.; Charvet, J.L. Grand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (France). 1993. [27p.] Order Number DE93626900. Source: OSTI; NTIS (US Sales Only); INIS.

Inclusive neutron multiplicity distributions were measured by means of 4 π liquid-scintillator detectors for Ar and Kr-induced reactions at 44 MeV/nucleon and 32 MeV/nucleon, respectively. For

all the systems studied, the observed distributions exhibit a bump structure at large multiplicity corresponding to highly dissipative collisions. For Ar-induced reactions, the excitation energies necessary to explain the most probable neutron multiplicity associated with these dissipative collisions are estimated, the correspondence between excitation energy and neutron multiplicity being calculated in the framework of the statistical model. The so-obtained values of excitation energies, which are systematically lower than those predicted using the massive-transfer picture, are discussed.

25105 (INDC(NDS)–204/GSp, pp. 111-112) **Data on charged-particle-induced reactions: Some problems.** Chukreev, F.E. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (Russian Federation). Inst. Atomnoj Ehnergii). International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Apr 1988. Translated from Russian. (CONF-871026–: IAEA Data Networking meeting, Upton, NY (United States), 26-30 Oct 1987). In *Report on the 9. IAEA consultants' meeting of the nuclear reaction data centres: Including the 20. four-centres meeting of the neutron data centres and the 10. meeting on charged particle nuclear data compilation.* [152p.] Order Number DE93626597. Source: OSTI; NTIS (US Sales Only); INIS.

The report shortly presents some of the difficult problems which should be solved by the Atomic and Nuclear Data Centre of the USSR State Committee on the Utilization of Atomic Energy in the nuclear reaction data compilation for the production of radionuclides of medical interest. 2 refs.

25106 (INDC(NDS)–204/GSp, pp. 145-152) **Summary of charged particle data collections.** Dunford, C.L. (National Nuclear Data Center, Upton, NY (United States)). International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Apr 1988. (CONF-871026–: IAEA Data Networking meeting, Upton, NY (United States), 26-30 Oct 1987). In *Report on the 9. IAEA consultants' meeting of the nuclear reaction data centres: Including the 20. four-centres meeting of the neutron data centres and the 10. meeting on charged particle nuclear data compilation.* [152p.] Order Number DE93626597. Source: OSTI; NTIS (US Sales Only); INIS.

The report reviews the data collections concerning the charged particle nuclear reactions, namely the bibliographies, the experimental data and the evaluated data. 12 refs, 3 figs, 1 tab.

25107 (INDC(NDS)–204/GSp, pp. 113-117) **CDFE for photonuclear researches.** Boboshin, I.N. (Moskovskij Gosudarstvennyj Univ., Moscow (Russian Federation). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki); Varlamov, V.V.; Surgutanov, V.V.; Khoronenko, A.A.; Chernjaev, A.P. International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Apr 1988. (CONF-871026–: IAEA Data Networking meeting, Upton, NY (United States), 26-30 Oct 1987). In *Report on the 9. IAEA consultants' meeting of the nuclear reaction data centres: Including the 20. four-centres meeting of the neutron data centres and the 10. meeting on charged particle nuclear data compilation.* [152p.] Order Number DE93626597. Source: OSTI; NTIS (US Sales Only); INIS.

The report is a review of the work carried out by the Centre for Experimental Photonuclear Data (CDFE), Moscow, mainly the computer processing of data in the EXFOR format and the evaluation of photonuclear data.

25108 (INDC(NDS)–205/GSp) **Measurement and analysis of double-differential neutron emission spectra in (P,N) and (α,N) reactions: Summary report.** Okamoto, K. (International Atomic Energy Agency, Vienna (Austria). Nuclear Data Section); Mehta, M.K. International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. May 1988. [13p.] (CONF-8802182–: 2. research co-ordination meeting on measurement and analysis of double-differential neutron emission spectra in (P,N) and (α,N) reactions, Vienna (Austria), 8-10 Feb 1988). Order Number DE93626882. Source: OSTI; NTIS (US Sales Only); INIS.

The second IAEA Research Co-ordination Meeting on Measurement and Analysis of Double-Differential Neutron Emission Spectra in (p,n) and (α,n) Reactions was convened by the IAEA Nuclear Data Section at the IAEA Headquarters in Vienna during 8-10 February, 1988. The main objectives of the Co-ordinated Research Project for which this meeting was held are (i) to extract systematic information about nuclear level densities as a function of excitation energy by analysing the neutron emission spectra from (p,n) and (α,n) reactions on properly selected targets and bombarding energy range, and (ii) to parametrize this information into appropriate phenomenological models to enable reliable extrapolation for general use of level density information in basic and applied nuclear physics related problems. Detailed conclusions and recommendations, together with a summary of the programme during 1988/1989 are attached in the Appendices.

25109 (INDC(NDS)–213/GM3, pp. 15-21) **Studies of the effect of the properties of neutron producing targets and sample backings on neutron cross section measurements.** Wasson, O.A. (National Inst. of Standards and Technology, Gaithersburg, MD (United States)); Schrack, R.A. International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Oct 1988. (CONF-8809159–: 14. world conference of the International Nuclear Target Development Society (INTDS): heavy-ion targets and related phenomena, Darmstadt (Germany), 5-9 Sep 1988). In *The influence of target and sample properties on nuclear data measurements: Summary report of the IAEA advisory group meeting in co-operation with the International Nuclear Target Development Society (INTDS), held in Darmstadt, Germany, 5-9 September 1988.* [74p.] Order Number DE93626092. Source: OSTI; NTIS (US Sales Only); INIS.

The use of pulsed-beam time-of-flight techniques to monitor the time dependence of the distribution of the neutron energy spectrum from lithium metal targets produced from the $^{7}Li(p,n)^{7}Be$ reaction is reviewed. The effect on the 14-MeV neutron angular distribution produced by the $T(d,n)^{4}He$ reaction by changes in the tritium distribution in the TiT target is investigated. The influence of the crystalline properties of sample backings and the use of x-ray powder diffraction to determine the stoichiometry of uranium oxide material are studied. (author). 4 refs, 7 figs.

25110 (INDC(NDS)–213/GM3, pp. 67) **The influence of target impurities on the accuracy of reaction cross section measurements.** Cheng Xiaowu (Academia Sinica, Shanghai, SH (China). Shanghai Inst. of Nuclear Research). International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Oct 1988. (CONF-8809159–: 14. world conference of the International Nuclear Target Development Society (INTDS): heavy-ion targets and related phenomena, Darmstadt (Germany), 5-9 Sep 1988). In *The influence of target and sample properties on nuclear data measurements: Summary report of the IAEA advisory group meeting in co-operation with the International Nuclear Target Development Society (INTDS), held in Darmstadt, Germany, 5-9 September 1988.* [74p.] Order Number DE93626092. Source: OSTI; NTIS (US Sales Only); INIS.

Inelastic scattering of protons on Ni isotopes has been measured at 25 MeV incident energy. Special attention has been paid to the low energy part of the energy spectra to study the isotopic effect on preequilibrium emission. H, C, and O contaminations on targets have been analyzed by backscattering and nuclear reaction, both before and after the experiment. Methods used to minimize the contamination and to deduct its contribution to the energy spectra will be described. The influence of target impurities on the accuracy of reaction cross sections will be discussed. (author). Abstract only.

25111 (INDC(NDS)–213/GM3, pp. 68) **On the influence of sample and target properties on the results of energy-dependent cross section measurements.** Winkler, G. (Vienna Univ. (Austria). Inst. fuer Radiumforschung und Kernphysik). International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Oct 1988. (CONF-8809159–: 14. world conference of the International Nuclear Target Development Society (INTDS): heavy-ion targets and related phenomena, Darmstadt (Germany), 5-9 Sep 1988). In *The influence of target and sample properties on nuclear data measurements: Summary report of the IAEA advisory group meeting in co-operation with the International Nuclear Target Development Society (INTDS), held in Darmstadt, Germany, 5-9 September 1988.* [74p.] Order Number DE93626092. Source: OSTI; NTIS (US Sales Only); INIS.

The impact of sample and target properties on the accuracy of experimental nuclear cross section data is discussed in the context

of the basic requirements in order to obtain reliable results from the respective measurements from the user's point of view. Special emphasis is put on activation measurements with fast neutrons. Some examples are given and suggestions are made based on experiences and recent investigations by the author and his coworkers. (author). Abstract only.

25112 (INDC(NDS)–213/GM3, pp. 68) **The influence of water absorption in a sample for neutron cross section measurements.** Mizumoto, Motoharu (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan)); Sugimoto, Madayoshi. International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Oct 1988. (CONF-8809159–: 14. world conference of the International Nuclear Target Development Society (INTDS): heavy-ion targets and related phenomena, Darmstadt (Germany), 5-9 Sep 1988). In *The influence of target and sample properties on nuclear data measurements: Summary report of the IAEA advisory group meeting in co-operation with the International Nuclear Target Development Society (INTDS), held in Darmstadt, Germany, 5-9 September 1988.* [74p.] Order Number DE93626092. Source: OSTI; NTIS (US Sales Only); INIS.

Sample-related corrections for average neutron cross section measurements are often complicated in the keV region due to the resonance structure. In particular, corrections for neutron multiple-scattering and self-shielding for chemical compound samples of rare earth materials should be carefully made, because they are highly hygroscopic. A Monte-Carlo method has been developed by taking into account the effects caused by neutron slowing down into the resonance region due to the scattering from hydrogen and oxygen atoms. The validity of calculated results for corrections has been investigated by comparing experimental data of oxide samples with those of metallic samples. The calculation method and related problems will be discussed in detail. (author). Abstract only.

25113 (INDC(NDS)–213/GM3, pp. 71) **On the fast neutron spectra shape in the nuclear constant measurement experiments with an electrostatic accelerator.** Tikhonov, S.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk (Russian Federation). Fiziko-Ehnergeticheskij Inst.); Shorin, V.S. International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Oct 1988. (CONF-8809159–: 14. world conference of the International Nuclear Target Development Society (INTDS): heavy-ion targets and related phenomena, Darmstadt (Germany), 5-9 Sep 1988). In *The influence of target and sample properties on nuclear data measurements: Summary report of the IAEA advisory group meeting in co-operation with the International Nuclear Target Development Society (INTDS), held in Darmstadt, Germany, 5-9 September 1988.* [74p.] Order Number DE93626092. Source: OSTI; NTIS (US Sales Only); INIS.

The approach to calculate the spectra of neutrons being produced in (p,n) reactions on the Van de Graaff accelerators has been considered. The model takes into account the actual layout of the solid tritium target and the irradiated sample as well as the target composition. The main spectrum parameters - the average energy E and the variants D - have been calculated for the real experiment. (author). Abstract only.

25114 (INDC(NDS)–213/GM3, pp. 71-72) **Problems associated with the production of monoenergetic neutrons.** Boettger, R. (Physikalisch-Technische Bundesanstalt, Braunschweig (Germany)); Guldbakke, S.; Klein, H.; Schoelermann, H.; Schuhmacher, H.; Strzelczyk, H. International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Oct 1988. (CONF-8809159–: 14. world conference of the International Nuclear Target Development Society (INTDS): heavy-ion targets and related phenomena, Darmstadt (Germany), 5-9 Sep 1988). In *The influence of target and sample properties on nuclear data measurements: Summary report of the IAEA advisory group meeting in co-operation with the International Nuclear Target Development Society (INTDS), held in Darmstadt, Germany, 5-9 September 1988.* [74p.] Order Number DE93626092. Source: OSTI; NTIS (US Sales Only); INIS.

Neutron producing reactions (1 keV < E_n < 19 MeV) have been investigated with respect to the neutron background production with the time-of-flight method employing pulsed proton or deuteron beams from the Van-de-Graaff accelerator. The largest fraction of background for the reaction $^{3}H(d,n)^{4}He$ results from a high impurity of deuterium in some solid Ti-T targets, whereas other background components can nearly fully be taken into account by a blank target measurement. Self target build-up was observed for an old Ti-D target, while for the $^{3}H(p,n)^{3}He$ reaction neutron scattering at the target construction, which could only partially be determined by backing thickness variation, was found to be a significant effect. The problems with LiF and metallic Li as target material for the $^{7}Li(p,n)^{7}Be$ reaction are discussed. In order to meet the desired resonance in the $^{45}Sc(p,n)^{45}Ti$ reaction, the energy of the protons has to be precisely determined by the time-of-flight method. (author). Abstract only.

25115 (INDC(NDS)–213/GM3, pp. 23-28) **Examples of problems caused by impurities in targets and/or research samples.** Adair, H.L. (Oak Ridge National Lab., Oak Ridge, TN (United States). Chemical Technology Div.). International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Oct 1988. Contract DE-AC05-84OR21400. (CONF-8809159–: 14. world conference of the International Nuclear Target Development Society (INTDS): heavy-ion targets and related phenomena, Darmstadt (Germany), 5-9 Sep 1988). In *The influence of target and sample properties on nuclear data measurements: Summary report of the IAEA advisory group meeting in co-operation with the International Nuclear Target Development Society (INTDS), held in Darmstadt, Germany, 5-9 September 1988.* [74p.] Order Number DE93626092. Source: OSTI; NTIS (US Sales Only); INIS.

It is important that the fabricators of research or production samples understand what problems impurities will cause. Thus, it is necessary that those individuals requesting targets or other samples discuss, in detail, what is required with the individuals responsible for preparing the samples. This will permit proper preparation procedures to be selected which will eliminate or reduce the impurity content that might otherwise jeopardize the intended use of the sample. Examples of problems caused by impurities in research and production samples are detailed. 2 refs, 4 figs, 1 tab.

25116 (INDC(NDS)–213/GM3, pp. 65) **The target for heavy ion physics.** Gono, Y. (Institute of Physical and Chemical Research, Wako, Saitama (Japan)); Ishihara, M. International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Oct 1988. (CONF-8809159–: 14. world conference of the International Nuclear Target Development Society (INTDS): heavy-ion targets and related phenomena, Darmstadt (Germany), 5-9 Sep 1988). In *The influence of target and sample properties on nuclear data measurements: Summary report of the IAEA advisory group meeting in co-operation with the International Nuclear Target Development Society (INTDS), held in Darmstadt, Germany, 5-9 September 1988.* [74p.] Order Number DE93626092. Source: OSTI; NTIS (US Sales Only); INIS.

We are engaged in researches on nuclear and atomic physics using heavy ion accelerators such as Linac, Tandem Van de Graaff, separate-sector cyclotron. Beam energies covered ranges from a few MeV/u to 100 MeV/u. The requirements for target properties widely vary with the individual research chosen and the type of beam used. Typical problems are concerned with thickness uniformity, heat tolerance, target preparation of non-metallic elements, density of gaseous target and so on. In this report we illustrate several specific examples of such problems encountered in current experiments. (author). Abstract only.

25117 (INDC(NDS)–213/GM3, pp. 66) **On the importance of target parameters in heavy ion positron spectroscopy.** Bokemeyer, H. (Gesellschaft fuer Schwerionenforschung mbH, Darmstadt (Germany)). International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Oct 1988. (CONF-8809159–: 14. world conference of the International Nuclear Target Development Society (INTDS): heavy-ion targets and related phenomena, Darmstadt (Germany), 5-9 Sep 1988). In *The influence of target and sample properties on nuclear data measurements: Summary report of the IAEA advisory group meeting in co-operation with the International Nuclear Target Development Society (INTDS), held in Darmstadt, Germany, 5-9 September 1988.* [74p.] Order Number DE93626092. Source: OSTI; NTIS (US Sales Only); INIS.

Details of the target constitution may represent important ingredients to the feasibility of heavy ion experiments. The central role of

such target characteristics will be exemplified using experiments on positron spectroscopy and related fields pursued with heavy ion beams of the GSI UNILAC-machine in Darmstadt. The scope includes the influence of the target compounds on both the basic physics and the background, the use of radioactive targets, the influence on ionic charge distributions, and the use of the stopping behaviour of the heavy ions for the measurement of the beam energy and the life-time discrimination by means of kinematic shifts. Targets bombarded by heavy ion beams suffer considerable deterioration. Thus the use of special techniques became important for the on- and off-line control of critical target parameters and will be introduced here. (author). Abstract only.

25118 (INDC(NDS)–213/GM3, pp. 66) **Fission foil characteristics.** Drapchinsky, L.V. (Radievyj Inst., Leningrad (Russian Federation)). International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Oct 1988. (CONF-8809159–: 14. world conference of the International Nuclear Target Development Society (INTDS): heavy-ion targets and related phenomena, Darmstadt (Germany), 5-9 Sep 1988). In *The influence of target and sample properties on nuclear data measurements: Summary report of the IAEA advisory group meeting in co-operation with the International Nuclear Target Development Society (INTDS), held in Darmstadt, Germany, 5-9 September 1988.* [74p.] Order Number DE93626092. Source: OSTI; NTIS (US Sales Only); INIS.

From the users' point of view the most important characteristics of fission samples are considered taking into account their influence on the final results of nuclear data measurements. (author). Abstract only.

25119 (INDC(NDS)–213/GM3, pp. 72) **^{243}Am targets for nuclear fission experiments: Requirements and realisation.** Mast, H. (Commission of the European Communities, Geel (Belgium). Central Bureau for Nuclear Measurements); Eykens, R.; Pauwels, J.; Wagemans, C. International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Oct 1988. (CONF-8809159–: 14. world conference of the International Nuclear Target Development Society (INTDS): heavy-ion targets and related phenomena, Darmstadt (Germany), 5-9 Sep 1988). In *The influence of target and sample properties on nuclear data measurements: Summary report of the IAEA advisory group meeting in co-operation with the International Nuclear Target Development Society (INTDS), held in Darmstadt, Germany, 5-9 September 1988.* [74p.] Order Number DE93626092. Source: OSTI; NTIS (US Sales Only); INIS.

Target characteristics required to carry out reliable thermal neutron induced fission studies on ^{243}Am are discussed. Especially the problems caused by the ingrowth of ^{239}Pu in the material are examined, and purification of the ^{243}Am base material is studied. The purification was carried out by anion exchange on Dowex-1 in HNO_3 medium, followed by cation exchange on Dowex-50 to eliminate iron introduced in the first purification step, and precipitation by NH_4OH to eliminate sodium. The material was then transformed into americium acetate and two targets were prepared by electrospraying. The targets were used for the study of the reaction characteristics and for the determination of the thermal neutron induced fission cross section. (author). Abstract only.

25120 (INDC(NDS)–256/S) **Status of thorium cycle nuclear data evaluations: Comparison of cross-section line shapes of JENDL-3 and ENDF-B-VI files for ^{230}Th, ^{232}Th, ^{231}Pa, ^{233}Pa, ^{232}U, ^{233}U and ^{234}U.** Ganesan, S. (International Atomic Energy Agency, Vienna (Austria). Nuclear Data Section); McLaughlin, P.K. International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Feb 1992. [138p.] Order Number DE93626883. Source: OSTI; NTIS (US Sales Only); INIS.

Since 1990, one of the most interesting developments in the field of nuclear data for nuclear technology applications is that several new evaluated data files have been finalized and made available to the International Atomic Energy Agency (IAEA) for distribution to its Member States. Improved evaluated nuclear data libraries such as ENDF/B-VI from the United States and JENDL-3 from Japan were developed over a period of 10-15 years. This report is not an evaluation of the evaluations. The report as presented here gives a first look at the cross section line shapes of the isotopes that are important to the thorium fuel cycle derived from the two recently evaluated data files: JENDL-3 and ENDF/B-VI. The basic evaluated data files JENDL-3 and ENDF/B-VI were point-processed successfully using the codes LINEAR and RECENT. The point data were multigrouped in three different group structures using the GROUPIE code. Graphs of intercomparisons of cross section line shapes of JENDL-3 and ENDF/B-VI are presented in this paper for the following isotopes of major interest to studies of the thorium fuel cycle: ^{230}Th, ^{232}Th, ^{231}Pa, ^{233}Pa, ^{232}U, ^{233}U and ^{234}U. Comparisons between JENDL-3 and ENDF/B-VI which were performed at the point and group levels show large discrepancies in various cross sections. We conclude this report with a general remark that it is necessary to perform sensitivity studies to assess the impacts of the discrepancies between the two different sets of data on calculated reactor design and safety parameters of specific reactor systems and, based on the results of such sensitivity studies, to undertake new tasks of evaluations. (author). 2 refs, 245 figs, 8 tabs.

25121 (INDC(NDS)–261/GSp) **Compilation and evaluation of fission yield nuclear data: Summary report of a consultants' meeting held in Vienna, 27-29 September 1989.** Lammer, M. (ed.) (International Atomic Energy Agency, Vienna (Austria). Nuclear Data Section). International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Sep 1991. [24p.] (CONF-8909498–: Consultants' meeting on compilation and evaluation of fission yield nuclear data, Vienna (Austria), 27-29 Sep 1989). Order Number DE93626933. Source: OSTI; NTIS (US Sales Only); INIS.

The task of this meeting was to review the progress made since the previous meeting on fission yield evaluation and to define the tasks for an IAEA Co-ordinated Research Programme in detail. Improvements have been noted in measured data, model calculations and the situation of fission yield evaluation. Tabs.

25122 (INDC(NDS)–262/GNC, pp. 30-37) **CDFE progress report - 1991.** Boboshin, I.N. (Moscow State Univ., Moscow (Russian Federation). CDFE, Inst. of Nuclear Physics); Varlamov, V.V.; Efimkin, N.G.; Sapunenko, V.V.; Stepanov, M.E. International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Mar 1992. (CONF-9110491–: 11. IAEA consultants' meeting of the nuclear reaction data centers, Obninsk (Russian Federation), 7-11 Oct 1991). In *11. IAEA consultants' meeting of the nuclear reaction data centers. Obninsk, 7-11 October 1991: Summary report.* [101p.] Order Number DE93626598. Source: OSTI; NTIS (US Sales Only); INIS.

The report is a review of the work carried out by the Centre for Experimental Photonuclear Data (CDFE), Moscow, Russia, to produce photonuclear experimental data files using EXFOR format. An Annex containing a draft proposal for a Photonuclear Data Cooperation Project between CDFE-Moscow State University and NNDC (US National Nuclear Data Center)-Brookhaven National Laboratory, is included. 4 refs.

25123 (INDC(NDS)–262/GNC, pp. 83-88) **Intermediate energy nuclear data at the Radium Institute.** Daniel, A.V. (Radievyj Inst., Leningrad (Russian Federation)); Perov, V.Yu.; Rubchenya, V.A.; Rimski-Korsakov, A.A. International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Mar 1992. (CONF-9110491–: 11. IAEA consultants' meeting of the nuclear reaction data centers, Obninsk (Russian Federation), 7-11 Oct 1991). In *11. IAEA consultants' meeting of the nuclear reaction data centers. Obninsk, 7-11 October 1991: Summary report.* [101p.] Order Number DE93626598. Source: OSTI; NTIS (US Sales Only); INIS.

The importance of intermediate energy nuclear data for technical applications is widely accepted. The key issue in this field is the correct Monte-Carlo calculation for target design of space- and energy distributions of various particles when it is irradiated by the primary beam. The 'inclusive' and 'exclusive' approaches which are usually considered are discussed here. 13 refs, 3 figs.

25124 (INDC(NDS)–263/GSp) **Activation cross sections for the generation of long-lived radionuclides of importance in fusion reactor technology: Texts of papers presented at the 1. meeting of a co-ordinated research programme held in Vienna, 11-12 November 1991.** Wang Dahai (comp.) (International Atomic Energy Agency, Vienna (Austria). Nuclear Data Section). International Atomic Energy Agency, Vienna (Austria). International

Nuclear Data Committee. Jul 1992. [159p.] (CONF-9111146–: 1. research co-ordination meeting on activation cross-sections for the generation of long-lived radionuclides of importance in fusion reactor technology, Vienna (Austria), 11-12 Nov 1991). Order Number DE93626884. Source: OSTI; NTIS (US Sales Only); INIS.

Following the recommendations of the International Nuclear Data Committee (INDC), the IAEA Nuclear Data Section has established a Co-ordinated Research Programme (CRP) on activation cross sections for the generation of long-lived radionuclides of importance in concentrating on the cross sections for the reactions suggested by the 16th INDC meeting. The first Research Co-ordination Meeting of the CRP was held at the IAEA Headquarters, Vienna, Austria, from 11 to 12 November 1991. The main objectives of the meeting were to review the results under the CRP and the status of long-lived activation cross section data and to fix the future working programme for the CRP. The proceedings contain the progress reports of the CRP and 12 contributed papers presented at the meeting as well as the summary of the conclusions and recommendations of the meeting. Refs, figs and tabs.

25125 (INDC(NDS)–263/GSp, pp. 17-20) **Activation cross section measurement and evaluation for the ^{23}Na(n,2n)^{22}Na reaction.** Lu Hanlin (Academia Sinica, Beijing, BJ (China). Inst. of Atomic Energy); Zhao Wenrong; Yu Weixiang. International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Jul 1992. (CONF-9111146–: 1. research co-ordination meeting on activation cross-sections for the generation of long-lived radionuclides of importance in fusion reactor technology, Vienna (Austria), 11-12 Nov 1991). In *Activation cross sections for the generation of long-lived radionuclides of importance in fusion reactor technology: Texts of papers presented at the 1. meeting of a co-ordinated research programme held in Vienna, 11-12 November 1991.* [159p.] Order Number DE93626884. Source: OSTI; NTIS (US Sales Only); INIS.

A large serious discrepancy exists in the published literatures and in two recent evaluations for the cross sections of ^{23}Na(n,2n)^{22}Na reaction. New experimental measurements have been performed in neutron energy range of 13-18 MeV by activation method for ^{23}Na(n,2n)^{22}Na reaction. Based on the new measurements and the trend of excitation function, the recommended data are given. (author). 16 refs, 2 figs, 2 tabs.

25126 (INDC(NDS)–263/GSp, pp. 21-26) **Activation cross section measurement for the ^{179}Hf(n,2n)^{178m2}Hf reaction.** Yu Weixiang (Academia Sinica, Beijing, BJ (China). Inst. of Atomic Energy); Lu Hanlin; Zhao Wenrong. International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Jul 1992. (CONF-9111146–: 1. research co-ordination meeting on activation cross-sections for the generation of long-lived radionuclides of importance in fusion reactor technology, Vienna (Austria), 11-12 Nov 1991). In *Activation cross sections for the generation of long-lived radionuclides of importance in fusion reactor technology: Texts of papers presented at the 1. meeting of a co-ordinated research programme held in Vienna, 11-12 November 1991.* [159p.] Order Number DE93626884. Source: OSTI; NTIS (US Sales Only); INIS.

As an important data for a fusion reactor there are not any experimental results for the cross section of the ^{179}Hf(n,2n)^{178m2}Hf reaction. So the cross section was measured in this work at neutron energy of 14 MeV. Meanwhile, we also gave the data for the cross section of the ^{180}Hf(n,2n)^{179m2}Hf reaction. (author). 5 refs, 4 figs, 5 tabs.

25127 (INDC(NDS)–263/GSp, pp. 27-29) **Measurement and analysis of ^{165}Ho(n,γ)^{166m}Ho reaction cross section.** Xia Yijun (Sichuan Univ., Chengdu, SC (China). Inst. of Nuclear Science and Technology); Wang Chunhao; Long Xianguan. International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Jul 1992. (CONF-9111146–: 1. research co-ordination meeting on activation cross-sections for the generation of long-lived radionuclides of importance in fusion reactor technology, Vienna (Austria), 11-12 Nov 1991). In *Activation cross sections for the generation of long-lived radionuclides of importance in fusion reactor technology: Texts of papers presented at the 1. meeting of a co-ordinated research programme held in Vienna, 11-12 November 1991.* [159p.] Order Number DE93626884. Source: OSTI; NTIS (US Sales Only); INIS.

The cross sections of the ^{165}Ho(n,γ)^{166m} Ho reaction have been studied in the energy range from 29 to 1100 kev, using Au as a standard. The upper limits of the reaction cross section in the energy region were estimated. The capture cross section of Ho to 1200 y isomeric state has been determined at 676 $\pm$ 114 kev neutron energy. The result is 2.9 $\pm$ 0.60 mb. (author). 2 refs, 2 tabs.

25128 (INDC(NDS)–263/GSp, pp. 31-32) **Excitation functions of ^{151}Eu(n,2n)^{150m}Eu and ^{159}Tb(n,2n)^{158}Tb reactions.** Qalm, S.M. (Forschungszentrum Juelich GmbH (Germany). Inst. fuer Chemie 1 - Nuklearchemie); Cserpak, F.; Csikai, J. International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Jul 1992. (CONF-9111146–: 1. research co-ordination meeting on activation cross-sections for the generation of long-lived radionuclides of importance in fusion reactor technology, Vienna (Austria), 11-12 Nov 1991). In *Activation cross sections for the generation of long-lived radionuclides of importance in fusion reactor technology: Texts of papers presented at the 1. meeting of a co-ordinated research programme held in Vienna, 11-12 November 1991.* [159p.] Order Number DE93626884. Source: OSTI; NTIS (US Sales Only); INIS.

Cross sections were measured for the formation of long-lived activation products ^{150m}Eu and ^{158}Tb in (n,2n) reactions on ^{151}Eu and ^{159}Tb, respectively, over the neutron energy range of 8.7 to 10.7 MeV. 1 fig.

25129 (INDC(NDS)–263/GSp, pp. 33-39) **Measurements and calculations of some activation cross sections for generation of long-lived radionuclides.** Csikai, J. (Kossuth Lajos Tudomanyegyetem, Debrecen (Hungary). Kiserleti Fizikai Tanszek). International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Jul 1992. Contract 1734/91. (CONF-9111146–: 1. research co-ordination meeting on activation cross-sections for the generation of long-lived radionuclides of importance in fusion reactor technology, Vienna (Austria), 11-12 Nov 1991). In *Activation cross sections for the generation of long-lived radionuclides of importance in fusion reactor technology: Texts of papers presented at the 1. meeting of a co-ordinated research programme held in Vienna, 11-12 November 1991.* [159p.] Order Number DE93626884. Source: OSTI; NTIS (US Sales Only); INIS.

Activation cross sections have been measured for ^{109}Ag(n,2n)^{108m}Ag, ^{63}Cu(n,)α^{60}Co, ^{134}Ba(n,2n)^{133}Ba, ^{134}Ba(n,p)^{134}Cs and ^{137}Ba(n,p)^{137}Cs reactions at 14.5 MeV. Excitation functions of ^{58}Ni(n,p)^{58m,g}Co, ^{115}In(n,2n)^{114m,g}In and ^{115}In(n,n')^{115m}In dosimetry reactions were also measured in the 2.1 and 14.8 MeV interval. Results were compared with existing data and calculations using the STAPRE and EXIFON codes. Cross section curves were calculated around 14 MeV by the EXIFON code for a number of reactions resulting long-lived ($T_{1/2}$>10y) radionuclides. (author). 11 refs, 7 figs, 1 tab.

25130 (INDC(NDS)–263/GSp, pp. 41-52) **Measurements of long-lived activation cross sections at 14.7 MeV in the inter-laboratory collaboration with ANL/LANL/JAERI.** Ikeda, Yujiro. (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan)); Konno, Chikara; Smith, D.L. International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Jul 1992. (CONF-9111146–: 1. research co-ordination meeting on activation cross-sections for the generation of long-lived radionuclides of importance in fusion reactor technology, Vienna (Austria), 11-12 Nov 1991). In *Activation cross sections for the generation of long-lived radionuclides of importance in fusion reactor technology: Texts of papers presented at the 1. meeting of a co-ordinated research programme held in Vienna, 11-12 November 1991.* [159p.] Order Number DE93626884. Source: OSTI; NTIS (US Sales Only); INIS.

Six long-lived activation cross sections at 14.7 MeV have been measured by using the FNS facility in order to provide experimental data meeting the requirement in the radioactive wastes disposal assessment in the D-T fusion reactor. The measurements were conducted under an inter-laboratory collaboration with ANL/LANL/JAERI. Measured data were compared with data available in the

literature and discussed in terms of accuracy needed for the requirement. (author). 11 refs, 5 figs, 5 tabs.

25131 (INDC(NDS)–263/GSp, pp. 53-69) **Measured fast-neutron activation cross sections of Ag, Cu, Eu, Fe, Hf, Ni, Tb and Ti at 10.3 and 14.8 MeV and for the continuum neutron spectrum produced by 7-MeV deuterons on a thick Be-metal target.** Meadows, J.W. (Argonne National Lab., Argonne, IL (United States). Engineering Physics Div.); Smith, D.L.; Greenwood, L.R.; Haight, R.C.; Ikeda, Y.; Konno, C. International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Jul 1992. Contract W-31-109-Eng-38;W-7405-Eng-36. (CONF-9111146–: 1. research co-ordination meeting on activation cross-sections for the generation of long-lived radionuclides of importance in fusion reactor technology, Vienna (Austria), 11-12 Nov 1991). In *Activation cross sections for the generation of long-lived radionuclides of importance in fusion reactor technology: Texts of papers presented at the 1. meeting of a co-ordinated research programme held in Vienna, 11-12 November 1991.* [159p.] Order Number DE93626884. Source: OSTI; NTIS (US Sales Only); INIS.

Four identical sample packets containing elemental Ag, Cu, Eu, Fe, Hf, Ni, Tb and Ti have been irradiated in three distinct accelerator neutron fields, at Argonne National Laboratory and Los Alamos National Laboratory, U.S.A., and Japan Atomic Energy Research Institute, Tokai, Japan, under the auspices of an International Atomic Energy Agency Coordinated Research Program to investigate the production of long-lived radionuclides for fusion waste disposal applications. Final experimental results are presented here for 13 distinct reactions which ultimately lead to production of the following activities: Ag-106m,108m; Co-60g; Cr-51; Eu-150g,-152g; Hf-175,-179m2; Mn-54; Sc-46g,-47,-48; Tb-158g. The neutron fluence standard used was Ni-58(n,p)Co-58. The measured data include differential cross section values at 10.3 and 14.8 MeV, and integral cross sections for the continuum neutron spectrum produced by 7-MeV deuterons incident on a thick Be-metal target. The U-238(n,f) cross section was also measured at 10.3 MeV as a consistency check on the experimental technique. Some of the results of this study are compared with corresponding values from earlier work at Argonne and from ENDF/B-VI. (author). Refs, 1 fig., 9 tabs.

25132 (INDC(NDS)–263/GSp, pp. 71-84) **Consistent activation cross section calculations for all stable isotopes of V, Cr, Mn, Fe, Co, Ni.** Avrigeanu, M. (Central Inst. of Physics, Bucharest (Romania). Inst. of Physics and Nuclear Engineering); Ivascu, M.; Avrigeanu, V. International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Jul 1992. Contract IAEA-R-3802/R4/RB. (CONF-9111146–: 1. research co-ordination meeting on activation cross-sections for the generation of long-lived radionuclides of importance in fusion reactor technology, Vienna (Austria), 11-12 Nov 1991). In *Activation cross sections for the generation of long-lived radionuclides of importance in fusion reactor technology: Texts of papers presented at the 1. meeting of a co-ordinated research programme held in Vienna, 11-12 November 1991.* [159p.] Order Number DE93626884. Source: OSTI; NTIS (US Sales Only); INIS.

Comparison of the available experimental fast neutron reaction excitation functions on all stable isotopes of the elements V, Cr, Mn, Fe, Co, and Ni with nuclear model calculations is presented. Neutron and charged-particle emission spectra have also been analyzed in order to validate the pre-equilibrium emission model calculations (with no free internal parameters). The trial procedure involved provides confidence in the nuclear-model parameter basis used and makes possible calculations of increased accuracy for activation cross sections in this mass range, required for applications. (author). 13 refs, 27 figs.

25133 (INDC(NDS)–263/GSp, pp. 85-102) **Calculations of long-lived isomer production in neutron reactions.** Chadwick, M.B. (Los Alamos National Lab., Los Alamos, NM (United States). Theoretical Div.); Young, P.G. International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Jul 1992. (CONF-9111146–: 1. research co-ordination meeting on activation cross-sections for the generation of long-lived radionuclides of importance in fusion reactor technology, Vienna (Austria), 11-12 Nov 1991). In *Activation cross sections for the generation of long-lived radionuclides of importance in fusion reactor technology: Texts of papers presented at the 1. meeting of a co-ordinated research programme held in Vienna, 11-12 November 1991.* [159p.] Order Number DE93626884. Source: OSTI; NTIS (US Sales Only); INIS.

We present theoretical calculations for the production of the long-lived isomers ^{93m}Nb (1/2-, 16 yr), ^{121m}Sn (11/2-, 55 yr), ^{166m}Ho (7-, 1200 yr), ^{184m}Re (8+, 165 d), ^{186m}Re (8+, 2x10^5 yr), ^{178}Hf (16+, 31 yr), ^{179m}Hf (25/2-, 25 d), and ^{192m}Ir (9+, 241 yr), all of which pose potential radiation activation problems in nuclear fusion reactors if produced in 14-MeV neutron-induced reactions. We consider (n,2n), (n,n'), and (n,γ) production modes and compare our results both with experimental data (where available) and systematics. We also investigate the dependence of the isomeric cross section ratio on incident neutron energy for the isomers under consideration. The statistical Hauser-Feshbach plus preequilibrium code GNASH was used for the calculations. Where discrete state experimental information was lacking, rotational band members above the isomeric state, which can be justified theoretically but have not been experimentally resolved, were reconstructed. (author). 16 refs, 10 figs, 4 tabs.

25134 (INDC(NDS)–263/GSp, pp. 103-125) **Evaluation of isomeric excitation functions in neutron induced reactions.** Grudzevich, O.; Ignatyuk, A.; Zolotarev, K. International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Jul 1992. (CONF-9111146–: 1. research co-ordination meeting on activation cross-sections for the generation of long-lived radionuclides of importance in fusion reactor technology, Vienna (Austria), 11-12 Nov 1991). In *Activation cross sections for the generation of long-lived radionuclides of importance in fusion reactor technology: Texts of papers presented at the 1. meeting of a co-ordinated research programme held in Vienna, 11-12 November 1991.* [159p.] Order Number DE93626884. Source: OSTI; NTIS (US Sales Only); INIS.

The possibilities of isomer levels experimental excitation functions description with theoretical models are discussed. It is shown that the experimental data in many cases can be described by theoretical models quite well without parameter fitting. However, large discrepancies are observed for some reactions. In our opinion, these discrepancies are due to uncertainties of discrete level schemes, schemes of gamma-transitions between levels and spin dependence of level density. Small values of isomeric ratios (< 0.1) have been described with the largest errors. The simple formulae for energy dependence of isomeric ratio for (n,g) reaction has been proposed. (author). 53 refs, 10 figs, 8 tabs.

25135 (INDC(NDS)–263/GSp, pp. 127-142) **Implications of the IAEA CRP on long-lived activation cross sections on waste disposal and materials recycling for fusion reactor materials.** Cheng, E.T. (TSI Research Inc., Solana Beach, CA (United States)). International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Jul 1992. (CONF-9111146–: 1. research co-ordination meeting on activation cross-sections for the generation of long-lived radionuclides of importance in fusion reactor technology, Vienna (Austria), 11-12 Nov 1991). In *Activation cross sections for the generation of long-lived radionuclides of importance in fusion reactor technology: Texts of papers presented at the 1. meeting of a co-ordinated research programme held in Vienna, 11-12 November 1991.* [159p.] Order Number DE93626884. Source: OSTI; NTIS (US Sales Only); INIS.

Waste disposal and materials recycling are important issues for the development of fusion power reactors. The recent criteria were summarized and discussed. The allowable concentrations of natural elements in the first wall and blanket components of a lithium self-cooled fusion blanket with vanadium structure, were assessed for the "Class C" shallow-land waste disposal consideration. The activation cross reactions recently developed under the IAEA Coordinated Research Program on Activation Cross Sections for the Generations of Long-Lived Radionuclides were incorporated to improve the REAC-2 library. Recommendations were given on measurements of some estimated cross sections: ^{158}Dy(n,p)^{158}Tb, ^{191}Ir(n,g)^{192m2}Ir, ^{180}Ta(n,t)^{178m2}Hf, ^{187}Re(n,2n)^{186m}Re and ^{185}Re(n,g)^{186m}Re. Another independent measurement on ^{179}Hf(n,2n)^{178m2}Hf was suggested. Measurements or estimates of transition cross sections for the long-lived radionuclides, namely

^{26}Al, ^{94}Nb, ^{108m}Ag, ^{158}Tb, ^{166m}Ho, ^{178m2}Hf, ^{186m}Re, and ^{192m2}Ir, were recommended for the investigation of long-term materials recycling issue. (author). 17 refs, 2 figs, 4 tabs.

25136 (INDC(NDS)–263/GSp, pp. 143-154) **Measurements of activation cross sections for some long-lived nuclides important in fusion reactor technology.** Blinov, M.V. (Radievyj Inst., Leningrad (Russian Federation)); Filatenkov, A.A.; Chuvaev, S.V. International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Jul 1992. (CONF-9111146–: 1. research co-ordination meeting on activation cross-sections for the generation of long-lived radionuclides of importance in fusion reactor technology, Vienna (Austria), 11-12 Nov 1991). In *Activation cross sections for the generation of long-lived radionuclides of importance in fusion reactor technology: Texts of papers presented at the 1. meeting of a co-ordinated research programme held in Vienna, 11-12 November 1991.* [159p.] Order Number DE93626884. Source: OSTI; NTIS (US Sales Only); INIS.

The Ag-109(n,2n)Ag-108m, Eu-151(n,2n)Eu-150 and Eu-153(n,2n)Eu-152 cross sections have been measured in the neutron energy interval of 13.7-14.9 MeV. The measurements were performed at the neutron generator NG-400 of the Radium Institute using (D-T) neutrons. At the same facility the upper limit has been obtained for the W-182(n,n'a)Hf-178m^2 cross section. Neutron capture of the Mo-98 that lead ultimately to the production of the long-lived Tc-99 has been studied at neutron energies 0.7-2.0 MeV. For these purposes, the Van de Graaf accelerator (EG-5) was employed that produced monochromatic neutrons in the (p-T) reaction. Both at EG-5 and NG-400 measurements, special efforts were made to minimize neutron spectrum impurities which unavoidably arise in irradiation environments. (author). 15 refs, 6 figs, 1 tab.

25137 (INDC(NDS)–265/G) **Total neutron cross-section of U-238 as measured with filtered neutrons of 55 keV and 144 keV.** Pham Zuy Hien (Dalat Nuclear Research Inst., Dalat (Viet Nam)); Vuong Huu Tan; Nguyen Phuoc Xuan. International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Oct 1992. [11p.] Order Number DE93626885. Source: OSTI; NTIS (US Sales Only); INIS.

In the piercing horizontal channel of the Dalat nuclear research reactor a 98m long silicon filter has been installed for producing quasi-monoenergetic neutrons of 55 keV and 144 keV. The flux intensities of the neutron beams are $4x10^6$n/cm^2·s (55 keV) and $1.2x10^7$n/cm^2·s (144 keV). Filtered neutron beams are being utilized for the measurements of the resonance-averaged nuclear parameters. In the first experiments aiming partly at testing the adequacy of the experimental conditions total neutron cross-sections have been measured by transmission technique for U-238 and C-12 target nuclei. The data for U-238 obtained with the accuracy of about 1% were compared with the evaluated ENDF/B-IV data and the results of recent experimental works. (author). 6 refs, 4 figs.

25138 (IPNO-DRE–92-22) **Coulomb instability in collisions between very heavy nuclei around 30 MeV per nucleon.** Borderie, B. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire); Rivet, M.F.; Remaud, B.; Sebille, F. Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire. Jul 1992. [6p.] Order Number DE93626901. Source: OSTI; NTIS (US Sales Only); INIS.

Simulations based on the Landau-Vlasov model, of central collisions (b=0-3fm) between very heavy nuclei around 30 MeV per nucleon reveal the occurrence of Coulomb instability as already predicted by static calculations of hot nuclei a few years ago.

25139 (IPNO-DRE–92-32) **Odd-odd nuclei around A = 184.** Ibrahim, F. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire); Bourgeois, C.; Kilcher, P.; Korichi, A.; Le Blanc, F.; Oms, J.; Perrin, N.; Popescu, D.G.; Roussiere, B.; Sauvage, J.; Sergolle, H.; Hojman, D.; Davidson, J.; Davidson, M.; DebParis-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire. 1992. [3p.] (CONF-920721–: 6. international conference on nuclei far from stability and 9th international conference on atomic masses and fundamental constants, Bernkastel-Kues (Germany), 19-24 Jul 1992). Order Number DE93626902. Source: OSTI; NTIS (US Sales Only); INIS.

An experiment has been performed in beam via the ^{165}Ho(^{24}Mg,5n)^{184}Au reaction using the 'Chateau de Cristal' multidetector in Orsay. We have identified in ^{184}Au some structures already observed in the neighboring odd-odd nuclei.

25140 (IPNO-DRE–92-35) **Study of the hot giant dipole resonance with the Medea detector.** Suomijaervi, T. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire); Le Faou, J.H.; Blumenfeld, Y.; Frascaria, N.; Garron, J.P.; Roynette, J.C.; Lamehi-Rachti, M.; Piattelli, P.; Agodi, C.; Alba, R.; Coniglione, R.; Del Zoppo, A.; FinocchiarParis-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire. 1992. [10p.] (CONF-9209347–: 1. Joint Italian-Japanese meeting on perspectives in heavy ion physics, Catania (Italy), 29 Sep - 3 oct 1992). Order Number DE93626903. Source: OSTI; NTIS (US Sales Only); INIS.

The characteristics of the giant dipole resonance in hot nuclei formed by incomplete fusion of ^{36}Ar + ^{90}Zr at 27 MeV/u have been measured at GANIL with the MEDEA detector. This set up allows the simultaneous measurement of γrays, light charged particles, and fusion residues. Preliminary results indicate that the giant dipole resonance shows up prominently in coincidence with the incomplete fusion residues which have a mean excitation energy of 550 MeV. A comparison of the spectra with statistical calculations using the code CASCADE is presented.

25141 (IPNO-DRE–92-37) **Dissociation reactions of the ^{11}Be one-neutron halo: the interplay between structure and reaction mechanism.** Anne, R. (Grand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (France)); Lewitowicz, M.; Saint-Laurent, M.G.; Arnell, S.E.; Jonson, B.; Nilsson, T.; Nyman, G.; Wilhelmsen Rolander, K.; Bimbot, R.; Dogny, S.; Guillemaud-Mueller, D.; Mueller, A.C.;.Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire. 1992. [9p.] Contract 06DA 184A. Order Number DE93626904. Source: OSTI; NTIS (US Sales Only); INIS.

Reactions of a radioactive ^{11} Be beam at 41 MeV/u have been investigated. The absolute magnitude of the differential cross-sections of the forward neutrons in the exclusive (^{10} Be + n) channel can be accounted for quantitatively in a simple model. The narrow distribution from high-Z targets turns out to arise from Coulomb dissociation whereas the broad distribution from the beryllium target is due to diffraction dissociation.

25142 (IPNO-T–92-03) **Study of induced reactions by a secondary beam of ^{11}Be in Be, Ti and Au targets.** Dogny, S. Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire. 27 Oct 1992. [92p.] (In French). Order Number DE93626905. Source: OSTI; NTIS (US Sales Only); INIS.

In the last decade, new phenomena arised from nuclear reaction studies of neutron-rich light nuclei produced by projectile fragmentation. In this work, first we will recall briefly some aspects of these studies, in particular the two-neutron halo for nuclei whose binding energy of the two last neutrons is low. Secondly, we will describe the experiment which aims to study ^{11} Be reactions on Be, Ti and Be targets. The results of this experiment show the presence of a one-neutron halo, corresponding to a high dissociation cross-section for the three targets. We will show that three mechanisms, Coulomb dissociation for heavy targets, diffraction-and absorption-dissociation for light targets, account satisfactorily for reactions leading to ^{10} Be.

25143 (JINR–5-51-91, pp. 14-22) **Clusterization of secondary particles in cumulative hadron and nucleus-nucleus interactions.** Angelov, N.; Lyubimov, V.B.; Togoo, R. Joint Inst. for Nuclear Research, Dubna (Russian Federation). 1991. [64p.] (In Russian). In *JINR rapid communications: Collection.* Order Number DE93626358. Source: OSTI; NTIS (US Sales Only); INIS.

It is found that higher temperatures and other structures of fragmentating systems corerspond more to the clusters with cumulative hadrons than to the ones without hadrons. The investigations have been performed using the 2-m propane bubble chamber at the Laboratory of High Energies JINR. 10 refs.; 4 figs.; 6 tabs.

25144 (JINR–5-51-91, pp. 5-13) **An experiment of the A-dependence of the cross section for relativistic deuteron fragmentation into cumulative pions.** Afanas'ev, S.V. (and

others); Anisimov, Yu.S.; Arkhipov, V.V. Joint Inst. for Nuclear Research, Dubna (Russian Federation). 1991. [64p.] In *JINR rapid communications: Collection.* Order Number DE93626358. Source: OSTI; NTIS (US Sales Only); INIS.

The power value of the A-dependence of the cross section for 4.5 GeV/c-A deuteron fragmentation into cumulative pions has been measured on carbon, aluminium, copper, and lead nuclei for cumulative numbers within 0.8-1.2. The mean value is equal to 0.27=0.09 in this interval. The target atomic weight dependence significantly differs from the volume type dependence in the atomic weight of fragmentally nucleus. 8 refs.; 6 figs.

25145 (JINR-D–7-91-481) **Formation of 102-element isotopes in $^{22}Ne+^{236}U$ and $^{26}Ng+^{232}Th$ reactions.** Andreev, A.N. (and others); Bogdanov, D.D.; Eremin, A.V. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of Nuclear Reactions. 1991. [24p.] (In Russian). Order Number DE93626906. Source: OSTI; NTIS (US Sales Only); INIS.

The formation of the isotopes in th e heavy-ion fusion reactions of $^{32}Ne+^{236}U$ and $^{24}Mg+^{237}Th$ has been investigated by using the kinematic separator VASSILISSA. Extracted fusion barriers from the neutron-evaporation-residue cross sections analysis for the fusion-fission reactions. 68 refs.; 7 figs.; 4 tabs.

25146 (JINR-E–1-92-56) **On studies of the hadron-nucleus collision processes.** Strugalski, Z. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of High Energy. 1992. [14p.] Order Number DE93626927. Source: OSTI; NTIS (US Sales Only); INIS.

A new way of hadron-nucleus collision process investigations in experiments is described. It is based on the properties of the hadron passage through layers of the intranuclear matter. The picture of the hadron-nucleus collision mechanism, as prompted experimentally, is presented. 37 refs.; 1 tab.

25147 (JINR-E–1-92-68) **Characteristics of the pion production and proton emission processes in proton-carbon nuclear collisions at 4.2 GeV/c momentum.** Strugalski, Z.; Sultanov, M. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of High Energy. 1992. [20p.] Order Number DE93626886. Source: OSTI; NTIS (US Sales Only); INIS.

The intensities of the pion production and protons emission in collisions at 4.2 GeV/c momentum are obtained in dependence on the intranuclear matter layer thickness involved in the collision reaction. Pions with large transversal momenta, larger than about 1.2 GeV/.c are presented in the reactions. 7 refs.; 12 figs.; 13 tabs.

25148 (JINR-E–1-92-69) **Characteristics of the pion production and nucleon emission processes in pion-carbon nuclear collisions at 40 GeV/.c.** Strugalski, Z.; Sultanov, M. Joint Inst. for Nuclear Research, Dubna (Russian Federation). 1992. [19p.] Order Number DE93626928. Source: OSTI; NTIS (US Sales Only); INIS.

Experimental data on pion-carbon nucleus collisions are presented. The momentum and energy spectra of protons emitted from the target nucleus do not depend on the intensity of the pion production in the collisions. 6 refs.; 12 figs.; 12 tabs.

25149 (JINR-E–2-92-64) **Pontecorvo reactions as a general class of antiproton annihilation on nuclei.** Kharzeev, D.E.; Nichitiu, F.; Sapozhnikov, M.G. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of Nuclear Problems. 1992. [11p.] Order Number DE93626888. Source: OSTI; NTIS (US Sales Only); INIS.

Reactions of antiproton annihilation forbidden on a free nucleon but allowed on a bound one are considered. It is shown that the investigation of these reactions can be essential in clarifying the role of non-nucleonic degrees of freedom in nuclei. 20 refs.; 4 figs.; 2 tabs.

25150 (JINR-E–2-92-264) **Relativistic impulse approximation and deuteron spin structure.** Tokarev, M.V. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of High Energy. 1992. [12p.] Order Number DE93626887. Source: OSTI; NTIS (US Sales Only); INIS.

The fragmentation processes were considered of tensor- and vector-polarized deuterons to protons in the framework of the covariant approach in the light cone variables on the basis of the relativistic deuteron wave function with one nucleon on-mass shell. The experimental verification of predicted dependences of T_{20} and K is of interest for the research of the momentum and spin distributions of high momentum deuteron constituents. 21 refs.; 6 figs.

25151 (JINR-E–4-92-113) **Data-to-data relations between elastic and inelastic scattering in nuclear rainbow region of angles.** Gareev, F.A. (and others); Ershov, S.N.; Mel'nikova, O.I. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of Theoretical Physics. 1992. [16p.] Order Number DE93626895. Source: OSTI; NTIS (US Sales Only); INIS.

It is shown that inelastic scattering cross sections, under suitable approximations, can be re-expressed in terms of the elastic scattering cross sections. 17 refs.; 8 figs.; 3 tabs.

25152 (LA-UR–93-1503) **Quasifree $(\vec{p}, \vec{n})$ reactions and enhancement of pionic processes.** McClelland, J.B. The E881 NTOF Collaboration. Los Alamos National Lab., NM (United States). [1993]. 17p. Sponsored by USDOE, Washington, DC (United States); National Science Foundation, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930389–5: Future directions in particle and nuclear physics at multi-GeV hadron beam facilities, Upton, NY (United States), 4-6 Mar 1993). Order Number DE93012746. Source: OSTI; NTIS; INIS; GPO Dep.

Results from a complete set of polarization-transfer observables for quasifree $(\vec{p}, \vec{n})$ scattering at 495 MeV are reported. Measurements were carried out on CD_2, carbon, and calcium targets at a laboratory scattering angle of 18° using the new Neutron Time-of-Flight facility at LAMPF. The ratio of spin-longitudinal to spin-transverse responses at a momentum transfer of approximately 1.72 fm^{-1} is extracted from the data, as well as the separated responses, and compared to distorted-wave calculations incorporating a Random-Phase Approximation description of the nuclear response. Thespin-transverse response is compared to (e,e′) measurements. The spin-longitudinal response represents new information available from hadron scattering.

25153 (LA-UR–93-1625) **Hypernuclear physics with a neutral meson spectrometer.** Peng, J.C. Los Alamos National Lab., NM (United States). [1993]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930389–11: Future directions in particle and nuclear physics at multi-GeV hadron beam facilities, Upton, NY (United States), 4-6 Mar 1993). Order Number DE93012712. Source: OSTI; NTIS; INIS; GPO Dep.

The (K^-, π^0) reaction, which complements the (K^-, π^-) and the (π^+, K^+) reactions, offers another means to study hypernuclear physics. The physics motivation for measuring the (K^-, π^0) reaction is discussed. The feasibility for detecting π^0 using the LAMPF Neutral Meson Spectrometer is studied with Monte-Carlo simulations. We conclude that the (K^-, π^0) reaction can be well measured at existing kaon beam lines.

25154 (UCRL-ID–111749) **Computer operation of the sensitive neutron counter.** Thorngate, J.H.; Hankins, D.E. Lawrence Livermore National Lab., CA (United States). Nov 1992. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE93014374. Source: OSTI; NTIS; GPO Dep.

We measure the neutrons emitted by small amounts of plutonium with a detector that consists of 16 ^3He proportional counters mounted in a large moderator and shield. Integrated circuits located near the proportional counter anode terminals amplify and shape the signals. We redesigned the remaining electronics to fit into a personal computer. the pulses produced by the proportional counters are recorded on commercially available timer/counter boards that plug into the computer. We built the power supplies required by the proportional counters on comparable plug-in boards. We wrote an extensive computer program to acquire, process, store, and print the data.

6635 Nuclear Mass Ranges

Refer also to citation(s) 25062, 25067, 25070, 25075, 25076, 25077, 25079, 25080, 25083, 25086, 25087, 25088, 25097, 25098, 25099, 25100, 25103, 25125, 25126, 25127, 25128, 25129, 25130,

25131, 25132, 25133, 25134, 25135, 25136, 25139, 25145, 25146, 25148, 25149, 25150, 25151, 25153, 25160

6636 Radiation Physics

Refer also to citation(s) 23481, 23482, 24179, 24346, 24564, 24565, 24973, 25103, 25233, 25387, 25397, 25400

25155 (CEA-CONF–11245) **Simulation of non-charged particles.** Morillon, B.; Both, J.P.; Nimal, J.C. CEA Centre d'Etudes de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Mecanique et de Technologie. 1992. [29p.] (In French). (CONF-9210355–: 117. National congress of Scientist Societies, Clermont-Ferrand (France), 26-30 Oct 1992). Order Number DE93626600. Source: OSTI; NTIS (US Sales Only); INIS.

This paper presents the method used to simulate the transport of neutral particles by using a Monte Carlo method with accelerating techniques of convergence based on the importance function by the method of first collision probabilities.

25156 (CONF-921102–60) **G. DeSaussure's early work.** Silver, E.G. Oak Ridge National Lab., TN (United States). [1992]. 19p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From Joint American Nuclear Society (ANS)/European Nuclear Society (ENS) international meeting on fifty years of controlled nuclear chain reaction: past, present, and future; Chicago, IL (United States); 15-20 Nov 1992. Order Number DE93009710. Source: OSTI; NTIS; INIS; GPO Dep.

This report discusses the work of Gerard deSaussure in the area of neutron physics research.

25157 (CONF-9304137–2) **The MASH 1.0 code system: Utilization of morse in the adjoint mode.** Johnson, J.O.; Santoro, R.T. Oak Ridge National Lab., TN (United States). [1993]. 19p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract AC05-84OR21400. From Centre d'Etudes meeting; Saclay (France); 27-29 Apr 1993. Order Number DE93013271. Source: OSTI; NTIS; GPO Dep.

The Monte Carlo Adjoint Shielding Code System – MASH 1.0, principally developed at Oak Ridge National Laboratory (ORNL), represents an advanced method of calculating neutron and gamma-ray environments and radiation protection factors for complex shielding configurations by coupling a forward discrete ordinates radiation environment (i.e. air-over-ground) transport calculation with an adjoint Monte Carlo treatment of the shielding geometry. The primary application to date has been to determine the radiation shielding characteristics of armored vehicles exposed to prompt radiation from a nuclear weapon detonation. Other potential applications include analyses of the mission equipment associated with space exploration, the civilian airline industry, and other problems associated with an external neutron and gamma-ray radiation environment. This paper will provide an overview of the MASH 1.0 code system, including the verification, validation, and application to "benchmark" experimental data. Attention will be given to the adjoint Monte Carlo calculation, the use of "in-group" biasing to control the weights of the adjoint particles, and the coupling of a new graphics package for the diagnosis of combinatorial geometry descriptions and visualization of radiation transport results.

25158 (DOE/ER/40333–137) **Detection of hot muonic hydrogen atoms emitted in vacuum using x-rays.** Jacot-Guillarmod, R. (Fribourg Univ. (Switzerland)); Bailey, J.M.; Beer, G.A.; Knowles, P.E.; Mason, G.R.; Olin, A.; Beveridge, J.L.; Marshall, G.M.; Brewer, J.H.; Forster, B.M.; Huber, T.M.; Kammel, P. Wyoming Univ., Laramie, WY (United States). [1992]. 6p. Sponsored by USDOE, Washington, DC (United States); Natural Sciences and Engineering Research Council of Canada, Ottawa, ON (Canada); Swiss National Science Foundation, Bern (Switzerland). DOE Contract FG02-87ER40333. (CONF-9204241–1: Ascona workshop on muonic atomic and molecules, Ascona (Switzerland), 5-9 Apr 1992). Order Number DE93010253. Source: OSTI; NTIS; INIS; GPO Dep.

Negative muons are stopped in solid layers of hydrogen and neon. Muonic hydrogen atoms can drift to the neon layer where the muon is immediately transferred. It was found that the time structure of the muonic neon X-rays follows the exponential law where the rate is the same as the disappearance rate of μ^-p atoms. The ppμ-formation rate and the muon transfer rate to deuterium are deduced.

25159 (DOE/ER/40333–138) **Hot muonic deuterium and tritium from cold targets.** Marshall, G.M. (TRIUMF, Vancouver, BC (Canada)); Beveridge, J.L.; Bailey, J.M.; Beer, G.A.; Knowles, P.E.; Mason, G.R.; Olin, A.; Brewer, J.H.; Forster, B.M.; Huber, T.M.; Pippitt, B.; Jacot-Guillarmod, R.; Schellenberg, L.; Kammel, P. Wyoming Univ., Laramie, WY (United States). [1992]. 10p. Sponsored by USDOE, Washington, DC (United States); Natural Sciences and Engineering Research Council of Canada, Ottawa, ON (Canada). DOE Contract FG02-87ER40333. (CONF-9204241–2: Ascona workshop on muonic atomic and molecules, Ascona (Switzerland), 5-9 Apr 1992). Order Number DE93010254. Source: OSTI; NTIS; INIS; GPO Dep.

Experiments are described which use a solid hydrogen layer to form muonic hydrogen isotopes in vacuum. The method relies on transfer of the muon from protium to either a deuteron or a triton. The resulting muonic deuterium or muonic tritium will not immediately thermalize because of the very low elastic cross sections, and may be emitted from the surface of the layer. Measurements which detect decay electrons, muonic x-rays, and fusion products have been used to study the processes. A target has been constructed which exploits muonic atom emission in order to study the energy dependence of transfer and muon molecular formation.

25160 (ECN-RX–92-040) **Direct and preequilibrium effects in the fission-product mass range: Papers presented in the NEANSC Specialists' Meeting on Fission Product Nuclear Data, 25-27 May 1992, JAERI, Japan.** Gruppelaar, H. (Netherlands Energy Research Foundation (ECN), Petten (Netherlands)); Hogenbirk, A. Netherlands Energy Research Foundation (ECN), Petten (Netherlands). Jul 1992. [20p.] (CONF-9205346–: Organization for Economic Cooperation and Development, Nuclear Energy Agency Nuclear Science Committee (NEANSC) specialists' meeting on Fission Product Nuclear Data, Tokaimura (Japan), 25-27 May 1992). Order Number DE93626951. Source: OSTI; NTIS; INIS.

Until recently inelastic scattering did not gain the proper attention in fission-product cross section evaluations. In many existing evaluations global spherical optical models have been used, neglecting direct and pre-equilibrium effects. There are also few experimental data relevant to inelastic scattering in fission products. This paper is focussed on the anomalously high inelastic scattering cross sections observed in even-mass nuclei near mass A=100 at low energies. Both more data and more refined theoretical analyses are required. A number of suggestions for relevant coupled-channel calculations is made. (author). 29 refs., 5 figs., 1 tab.

25161 (EGG-M–92469) **The searchlight problem for neutrons in a semi-infinite medium.** Ganapol, B.D. (Arizona Univ., Tucson, AZ (United States). Dept. of Nuclear and Energy Engineering); Nigg, D.W.; Jahshan, S.N.; Wemple, C.A. EG and G Idaho, Inc., Idaho Falls, ID (United States). [1993]. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-76ID01570. (CONF-930404–14: International topical meeting on mathematical methods and supercomputing in nuclear applications (M&C+SNA '93), Karlsruhe (Germany), 19-23 Apr 1993). Order Number DE93010796. Source: OSTI; NTIS; INIS; GPO Dep.

The solution of the Search Light Problem for monoenergetic neutrons in a semi-infinite medium with isotropic scattering illuminated at the free surface is obtained by several methods at various planes within the medium. The sources considered are a normally-incident pencil beam and an isotropic point source. The analytic solution is effected by a recently developed numerical inversion technique applied to the Fourier-Bessel transform. This transform inversion results from the solution method of Rybicki, where the two-dimensional problem is solved by casting it as a variant of a one-dimensional problem. The numerical inversion process results in a highly accurate solution. Comparisons of the analytic solution with results from Monte Carlo (MCNP) and discrete ordinates transport (DORT) codes show excellent agreement. These comparisons, which are free of any associated data or cross section set dependencies, provide significant evidence of the proper operation of both the transport codes tested.

25162 (LA–12570) **Analytic score distributions and moments for a spatially continuous tridirectional Monte Carlo transport problem.** Booth, T.E. Los Alamos National Lab., NM (United States). Jul 1993. 49p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. Order Number DE93014012. Source: OSTI; NTIS; GPO Dep.

The interpretation of the statistical error estimates produced by Monte Carlo transport codes is still somewhat of an art. Empirically, there are variance reduction techniques whose error estimates are almost always reliable and there are variance reduction techniques whose error estimates are often unreliable. Unreliable error estimates usually result from inadequate large score sampling from the score distribution's tail. Statisticians believe that more accurate confidence interval statements are possible if the general nature of the score distribution can be characterized. This paper provides the analytic score distribution for the exponential transform applied to a simple spatially continuous Monte Carlo transport problem.

25163 (LA-UR–93-1338) **Distributed processor Monte Carlo: MCNP results on a 16-node IBM cluster.** McKinney, G.W. Los Alamos National Lab., NM (United States). [1993]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9304131–1: Advanced Monte Carlo computer programs for radiation transport, Saclay (France), 27-29 Apr 1993). Order Number DE93012639. Source: OSTI; NTIS; GPO Dep.

The advent of high-performance computer systems has brought to maturity programming concepts like vectorization, multiprocessing, and multitasking. Although there are many schools of thought as to the most significant factor in obtaining order-of-magnitude increases in performance, such speedup can only be achieved by integrating the computer system and application code. Vectorization leads to faster manipulation of arrays by overlapping instruction CPU cycles. Discrete ordinates codes, which require the solving of large matrices, have proved to be major benefactors of vectorization. Monte Carlo transport, on the other hand, typically contains numerous logic statements and requires extensive redevelopment to benefit from vectorization. Multiprocessing and multitasking provide additional CPU cycles via multiple processors. Such systems are generally designed with either common memory access or distributed memory access. In both cases, theoretical speedup, as a function of the number of processors (P) and the fraction of task time that multiprocesses (f), can be formulated using Amdahl's Law S(f, P) = 1/(1 – f + f /P). However, for most applications this theoretical limit cannot be achieved, due to additional terms not included in Amdahl's Law. Monte Carlo transport is a natural candidate for multiprocessing, since the particle tracks are generally independent and the precision of the result increases as the square root of the number of particles tracked.

25164 (LA-UR–93-1392) **Hybrid S_N/Monte Carlo research and results.** Baker, R.S. Los Alamos National Lab., NM (United States). [1993]. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9304131–2: Advanced Monte Carlo computer programs for radiation transport, Saclay (France), 27-29 Apr 1993). Order Number DE93012677. Source: OSTI; NTIS; INIS; GPO Dep.

The neutral particle transport equation is solved by a hybrid method that iteratively couples regions where deterministic (S_N) and stochastic (Monte Carlo) methods are applied. The Monte Carlo and S_N regions are fully coupled in the sense that no assumption is made about geometrical separation or decoupling. The hybrid Monte Carlo/S_N method provides a new means of solving problems involving both optically thick and optically thin regions that neither Monte Carlo nor S_N is well suited for by themselves. The hybrid method has been successfully applied to realistic shielding problems. The vectorized Monte Carlo algorithm in the hybrid method has been ported to the massively parallel architecture of the Connection Machine. Comparisons of performance on a vector machine (Cray Y-MP) and the Connection Machine (CM-2) show that significant speedups are obtainable for vectorized Monte Carlo algorithms on massively parallel machines, even when realistic problems requiring variance reduction are considered. However, the architecture of the Connection Machine does place some limitations on the regime in which the Monte Carlo algorithm may be expected to perform well.

25165 (SAND–93-0200) **Proton transport methods for satellite shield modeling.** Drumm, C.R. Sandia National Labs., Albuquerque, NM (United States). Mar 1993. 45p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. Order Number DE93013602. Source: OSTI; NTIS; GPO Dep.

Satellite electronics may be subjected to a large fluence of protons from the Van Allen belt and from solar flares. To determine if unhardened electronics will survive a radiation environment, the total ionizing dose and displacement damage to the electronics must be determined. Several computer codes are available for modeling proton transport, ranging in complexity for a very-efficient straight-line approximation to general-geometry time-dependent Monte Carlo transport, with corresponding increase in computer run time. For most satellite applications, neutrons can be neglected in the analysis. However, neutrons may be important for modeling heavily shielded compartments for personnel and electronics.

25166 (SAND–93-0901C) **Physical optics modelling of soft x-ray projection lithography (SXPL) imaging experiments.** Chow, W.W. (Sandia National Labs., Albuquerque, NM (United States)); Sweatt, W.C.; Lawrence, G.N.; Jewell, T.E. Sandia National Labs., Albuquerque, NM (United States). [1993]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-9305159–2: Optical Society of America (OSA) topical meeting on soft x-ray projection lithography, Monterey, CA (United States), 10-12 May 1993). Order Number DE93011556. Source: OSTI; NTIS; GPO Dep.

We report our progress on the physical optics modelling of Sandia/AT&T SXPL experiments. The code is benchmarked and the 10X Schwarzchild system is being studied.

25167 (WAPD-TM–1623) **Improved approximate formulas for flux from cylindrical and rectangular sources.** Wallace, O.J.; Bokharee, S.A. Bettis Atomic Power Lab., West Mifflin, PA (United States). Mar 1993. 66p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC11-89PN38014. Order Number DE93011390. Source: OSTI; NTIS; GPO Dep.

This report provides two new approximate formulas for the flux at detector points outside the radial and axial extensions of a homogeneous cylindrical source and improved approximate formulas for the flux at points opposite rectangular surface sources. These formulas extend the range of geometries for which analytic approximations may be used by shield design engineers to make rapid scoping studies and check more extensive calculations for reasonableness. These formulas can be used to support skeptical, independent evaluations and are also valuable teaching tools for introducing shield designers to complex shield analyses.

6640 Atomic and Molecular Physics

Refer also to citation(s) 25074, 25116

25168 (ORNL/FTR–4572) **[Physics research in Denmark, Sweden, and Japan]: Foreign trip report, March 9–28, 1993.** Datz, S. Oak Ridge National Lab., TN (United States). 2 Apr 1993. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93012553. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The traveler presided over Executive Committee and Program Committee Meetings of the International Conference on the Physics of Electronic and Atomic Collisions in Aarhus, Denmark. He participated in experiments to measure dissociative recombination of H_3^+ and HeH^+ using the Heavy Ion Storage Ring (CRYRING) at the Manne Siegbahn Institute (MSI) in Stockholm, Sweden. He also participated in a Forum on Radioactive Nuclear Beams and Muon Beams in Kobe, Japan, where he presented an invited paper on "The Use of Muon Beams in Atomic Physics and A Method to Increase Flux of Radioactive Beams Using Crystal Channeling."

25169 (UCRL-JC–107601) **X-ray conversion in preformed plasmas.** Suter, L.J. (Lawrence Livermore National Lab., CA

(United States)); Kauffman, R.L.; Cray, M. Lawrence Livermore National Lab., CA (United States). 4 Nov 1991. 18p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9110326–2: European conference on laser interaction with matter (ECLIM), Warsaw (Poland), 21-25 Oct 1991). Order Number DE93013347. Source: OSTI; NTIS; GPO Dep.

The authors have carried out 1D and 2D calculational investigations which show that large, preformed plasmas can have higher x-ray conversion efficiencies than discs at the same irradiation intensity. In some situations, the x-ray conversion efficiency can approach 90%. Of the three common theoretical components of conversion efficiency (atomic physics, heat transport, power balance), they believe that changes to the power balance, due to changes in the hydrodynamics, is the mechanism by which preformed plasmas can have a higher conversion efficiency. They draw a more general conclusion from this work; in a world in which atomic physics and heat transport are "fixed", it may be possible to engineer conversion efficiency via changes that modify the power balance. The situation they model assumes a preformed plasma produced by a radiation pulse or a laser pulse. A 1ns preforming pulse, which in this work had a flux of $\sim 2.5 \times 10^{14}$ w/cm^2, strikes a gold target which may be either a sphere or a slab. The authors wait some delay time to allow plasma to evolve. Then they fire a 3ns, 3ω laser pulse into the preformed plasma. In this paper they discuss modelling results for three situations: a spherical preformed, spherically illuminated plasma; an infinite preformed plasma slab, infinitely illuminated; and an infinite preformed plasma slab illuminated with a finite size spot. The parameters of this study are delay time (which varies the scalelength of the preformed plasma) and laser intensity. The resulting plasmas for delay times of 3ns, 6ns and 10ns have scale lengths of $\sim 200\mu$m, $\sim 500\mu$m and $\sim$1mm, respectively.

25170 (UCRL-JC–111868) **Highly charged ions in hot, dense plasmas.** Osterheld, A.L.; Walling, R.S.; Young, B.K.F.; Goldstein, W.H.; Shimkaveg, G.; MacGowan, B.J.; Da Silva, L.; Keane, C.; Hammel, B.; London, R.; Stewart, R.E. Lawrence Livermore National Lab., CA (United States). Sep 1992. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-920948–12: 6. international conference on physics of highly charged ions, Manhattan, KS (United States), 28 Sep - 2 oct 1992). Order Number DE93013348. Source: OSTI; NTIS; GPO Dep.

Highly-charged ions play a critical role in hot, dense plasmas. They affect the energy balance and hydrodynamic evolution of transient plasmas. The radiation emitted by highly charged ions may be used in several practical applications, such as inertial confinement fusion, short wavelength lasers, and x-ray sources for lithography and microscopy applications. This radiation may also be used to diagnose the conditions in plasmas. In recent years, models have been developed to describe the atomic kinetics of complex ionization states of highly charged ions in plasmas. However, reliable atomic calculations and careful experiments which test both the fundamental atomic physics and the assumptions of the plasma emission models are required.

6641 Theory of Electronic Structure of Atoms and Molecules

25171 (INDC(NDS)–202/GA, pp. 19-21) **Data centers on atomic spectroscopy at the National Bureau of Standards.** Martin, W.C. (National Inst. of Standards and Technology, Gaithersburg, MD (United States)); Wiese, W.L. International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Feb 1988. (CONF-8711366–: 7. meeting of the Atomic and Molecular Data Centre Network, Oak Ridge, TN (United States), 9-11 Nov 1987). In *7. meeting of the Atomic and Molecular Data Centre Network, Oak Ridge National Laboratory, Oak Ridge, TN, 9-11 November 1987: Summary report.* [54p.] Order Number DE93626599. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. ENERGY LEVELS/data compilation; ENERGY LEVELS/information systems; SPECTRA/data compilation; SPECTRA/information systems; MOLYBDENUM IONS; NICKEL IONS; PROGRESS REPORT; SCANDIUM IONS; SPECTRA; US NBS

6642 Spectra of Atoms and Molecules and Their Interactions With Photons

Refer also to citation(s) 24038, 24118, 24287, 24288, 25171, 25195, 25241, 25243, 25323

25172 (CONF-9205147–5) **Coherence effects in radiometry and in spectroscopy.** Wolf, E. (Rochester Univ., NY (United States)). Rochester Univ., NY (United States). Dept. of Physics and Astronomy. [1992]. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-90ER14119. From 10. symposium on energy engineering sciences: synergism of analysis, modeling, and experiment; Argonne, IL (United States); 11-13 May 1992. Order Number DE93013437. Source: OSTI; NTIS; INIS; GPO Dep.

Some recent researches are described concerning the effects of the state of coherence of a source on the spatial and the spectral distributions of energy generated by the source. The researches have elucidated the foundations of radiometry and they have also revealed some unexpected new phenomena relating to spectral changes which can be induced by source correlations and also by scattering on random media.

25173 (DOE/ER/13191–13) **Kinetic studies following state-selective laser excitation: Progress report, May 1, 1990–April 29, 1993.** Keto, J.W. Texas Univ., Austin, TX (United States). Dept. of Physics. Oct 1992. 44p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG05-84ER13191 ;FG03-93ER14348. Order Number DE93012970. Source: OSTI; NTIS; INIS; GPO Dep.

Measurements of state-to-state deactivation cross sections and radiative lifetimes were made for Xe*(6p,6p',7p) and Kr*(5p) states in xenon and krypton buffer gases. These results are relevant to kinetic models of both excimer lasers and the infrared xenon laser. Attempts were made to continue studies of two-photon laser assisted collisions in the reaction $Xe + Cl_2 + \hbar\omega \rightarrow (Xe^+{}_oCl_2{}^-) \rightarrow XeCl^*(high\ v) + Cl$. These experiments along with studies of the XeCl*(B, C, and D) branching fractions are reported along with studies of the two-photon spectroscopy of Cl_2. In addition, significant progress was made in the study of the spectroscopy of small molecules and excimers formed in supersonic beams. Although emphasis is on xenon excimers excited in two-photon transitions, larger rare gas clusters were measured splitting between the 2s and 2p excitons is not explainable by currently excepted models for excitons in liquid xenon. Finally, work to obtain fluorescent spectra of xenon excimers in supersonic jets is described.

25174 (DOE/ER/13456–50) **Photodetachment studies on few-electron atomic negative ions.** Pegg, D.J. Tennessee Univ., Knoxville, TN (United States). Dept. of Physics. [1992]. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG05-85ER13456. (CONF-9210339–1: Workshop on atomic physics, Ithaca, NY (United States), Oct 1992). Order Number DE93008474. Source: OSTI; NTIS; INIS; GPO Dep.

A crossed laser-negative ion beams apparatus, situated at Oak Ridge National Laboratory has been used for energy and angle-resolved photoelectron spectroscopic measurements following photodetachment. In the current grant period measurements of the cross sections for photodetaching an electron from the Li^- ion were finished. Measurements of the $\sigma(B^-)/\sigma(Li^-)$ ratio, with a goal of determining photodetachment cross section for B^-, were started. An investigation of the photodetachment of the metastable ion Be^- also began. Preliminary data on the electron affinity, asymmetry parameter and cross section associated with the photodetachment of Be^- at a photon energy of 2.076 eV is reported.

25175 (DOE/ER/45316–T1) **Structure stability and spectroscopy of metal clusters: Progress report.** Virginia Commonwealth Univ., Richmond, VA (United States). [1993]. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG05-87ER45316. Order Number DE93016142. Source: OSTI; NTIS; GPO Dep.

Theory based on self-consistent field-linear combinations of atomic orbitals-molecular orbital theory was applied to clusters. Four areas were covered: electronic structure, equilibrium geometries, and stability of charged clusters, interaction of metal clusters with H and halogen atoms, thermal stability of isolated clusters, and stability and optical properties of hetero-atomic clusters. (DLC)

25176 (INDC(NDS)–202/GA, pp. 30-40) **GAPHYOR Data Center. Progress report 1986-1987.** Delcroix, J.L. (Paris-11 Univ., 91 - Orsay (France). Centre de Donnees GAPHYOR); Katsonis, K. International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Feb 1988. (CONF-8711366–: 7. meeting of the Atomic and Molecular Data Centre Network, Oak Ridge, TN (United States), 9-11 Nov 1987). In *7. meeting of the Atomic and Molecular Data Centre Network, Oak Ridge National Laboratory, Oak Ridge, TN, 9-11 November 1987: Summary report.* [54p.] Order Number DE93626599. Source: OSTI; NTIS (US Sales Only); INIS.

This Progress Report on the GAPHYOR Data Center for the period 1986-1987 provides statistics on the number of entries and a table of contents as well as the general introduction of the Elsevier North-Holland publication of the Gas-Phase Chemical Physics data base. It also describes recent technical developments, new automatic methods of error detection, on-line retrieval, and numerical data activities.

25177 (LA-UR–93-1408) **Source to detector spectrum transformation and its inverse for the Pegasus Z-pinch.** Matuska, W.; Lee, Huan; Hockaday, R.; Peterson, D. Los Alamos National Lab., NM (United States). [1993]. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9304126–2: 3. international conference on dense z-pinches, London (United Kingdom), 19-23 Apr 1993). Order Number DE93012674. Source: OSTI; NTIS; GPO Dep.

We have developed a ray-tracing code which enables us to calculate the spectrum from a 2-D source simulation and compare directly with experimental data. This code also allows us to study the various spectral components which can potentially be used to determine the source from measured data.

25178 (PNL–8629) **Excitation rate and background measurements during LIF studies on krypton.** Whitehead, C.A.; Cannon, B.D.; Wacker, J.F. Pacific Northwest Lab., Richland, WA (United States). Apr 1993. 21p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93013500. Source: OSTI; NTIS; GPO Dep.

The Krypton Isotope Laser Analysis (KILA) method is being developed at the Pacific Northwest Laboratory (PNL) to measure ^{85}Kr concentrations in small air samples. The technique uses high-resolution lasers to excite individual isotopes of krypton specifically to induce ^{85}Kr to fluorescence for detection by optical means. Production of krypton metastables via two-photon excitation to the $2p_6$ state has been shown to be 0.15% efficient in 0.13 mTorr of krypton–sufficiently high to demonstrate overall feasibility of the KILA method. Since this goal was met, focus has been directed toward development of a working vacuum ultraviolet (VUV) fluorescence detection system and toward understanding the VUV background. This report describes the progress made in these two areas. The second step of the KILA process is to optically pump all except the ^{85}Kr isotopes from the metastable state back to the ground state using laser-induced fluorescence (LIF). The rate of this process and the VUV background afterward will determine the sensitivity and selectivity of the KILA approach. De-excitation of the metastable population was accomplished via one-photon absorption of a continuous-wave (c-w) laser to the $2p_8$ energy level. Non-isotopically selective de-excitation rates as high as 5×10^5 sec^{-1} have been measured, yielding a signal-to-background ratio of $>10^6$. The lifetime of the metastables is 1.2 msec in 200 mTorr of neon–much longer than the time required to de-excite krypton metastables and to detect fluorescence produced by ^{85}Kr. After attaining these high de-excitation rates, a gated VUV detection system was built with a dynamic range large enough to measure a small background following de-excitation of large metastable populations. Future experiments will focus on reducing the background level by another 2–3 orders of magnitude and perfecting the isotopically selective de-excitation technique with known samples.

25179 (UCRL-CR–103295-92) **High resolution stimulated brillouin spectroscopy in glasses and crystals.** Faris, G.W. (SRI International, Menlo Park, CA (United States). Molecular Physics Lab.); Jusinski, L.E.; Hickman, A.P. Lawrence Livermore National Lab., CA (United States). 24 Apr 1992. 47p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE93013135. Source: OSTI; NTIS; GPO Dep.

Theory and measurements are presented for stimulated Brillouin gain spectroscopy in anisotropic media. The coupling between arbitrary pump and Stokes waves and the corresponding acoustic wave is formulated in terms of the elastic displacement vector and the photoelastic tensor. A propagation equation that fully includes transient effects is obtained for the Stokes wave. In the limit of small signal gains, this propagation equation can be solved analytically, yielding expressions that relate experimentally accessible quantities to material properties. Absolute Brillouin steady-state gain coefficients, linewidths, and frequency shifts are thereby determined in a number of optical materials at 532 nm. The Brillouin gain coefficient for fused silica is measured by three techniques, providing the reference for absolute gain measurements. Quantitative agreement is found between theory and experiment for transient effects on stimulated Brillouin scattering.

25180 (UCRL-ID–112298) **High-order harmonic conversion efficiency in helium.** Crane, J.K. Lawrence Livermore National Lab., CA (United States). 23 Oct 1992. 24p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE93011714. Source: OSTI; NTIS; INIS; GPO Dep.

Calculated results are presented for the energy, number of photons, and conversion efficiency for high-order harmonic generation in helium. The results show the maximum values that we should expect to achieve experimentally with our current apparatus and the important parameters for scaling this source to higher output. In the desired operating regime where the coherence length, given by $L_{coh}=\pi b/(q-1)$, is greater than the gas column length, l, the harmonic output can be summarized by a single equation: $N_q=[(\pi^2 n^2 b^3 \tau_q |d_q|^2)/4h]\{(p/q)(2l/b)^2\}$. N_q - numbers of photons of q-th harmonic; n - atom density; b - laser confocal parameter; τ_q - pulse width of harmonic radiation; q - harmonic order; p - effective order of nonlinearity. (Note the term in brackets, the phase-matching function, has been separated from the rest of the expression in order to be consistent with the relevant literature).

25181 (UCRL-JC–110217) **X-ray production ~130 Å from laser-produced plasmas for projection x-ray lithography applications.** Kauffman, R.L.; Phillion, D.W.; Spitzer, R.C. Lawrence Livermore National Lab., CA (United States). 30 May 1992. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9204120–5: Soft-x-ray projection lithography topical meeting, Monterey, CA (United States), 6-8 Apr 1992). Order Number DE93009256. Source: OSTI; NTIS; INIS; GPO Dep.

X-ray production in the region around 130 Å from laser-produced plasmas have been investigated as a source for projection x-ray lithography. The dependence of x-ray conversion efficiency on target material, intensity, and pulse length has been studied using a 0.53 μm laser with a maximum of 0.3 J. Conversion efficiency of 1% into a 3 Å bandwidth has been demonstrated for Sn targets at intensities around 10^{11} W/cm^2 using a 7.5 ns pulse. Intensity scaling suggests that laser spot size and two-dimensional expansion are important for optimizing x-ray production at these low irradiation intensities.

6643 Collision Phenomena

Refer also to citation(s) 25176, 25199, 25241, 25242, 25243, 25244, 25245, 25246, 25247, 25248, 25249, 25254, 25255, 25257, 25258, 25259, 25260, 25261, 25262, 25263, 25264, 25265

25182 (CONF-9209221–, pp. 335-352) **Fundamental parameters and interactions of positrons with molecules.** Schrader, D.M. (Marquette Univ., Milwaukee, WI (US)); Hulett, L.D. Jr. Oak Ridge National Lab., TN (United States). Apr 1993. From Department of Energy (DOE) task force meeting workshop on the application of positron spectroscopy to materials sciences; Miranch

Mirage, CA (United States); 9-11 Sep 1992. In *DOE workshop meeting on the application of positron spectroscopy to materials sciences: Proceedings.* 395p. Order Number DE93012784. Source: OSTI; NTIS.

Two important types of low-energy gas phase ionization and rearrangement reactions between positrons and molecules are considered: (a) those leading to species containing bound positronium, and (b) those resulting in fragmentation of the molecule. In simple cases of type (a) reactions, the energetics are transparent, but the quantum mechanics are understood only in outline; for type (b) reactions, surprising results are observed which are not yet well understood.

25183 (DOE/ER/13971–20) **Measurements of scattering processes in negative ion-atom collisions: Technical progress report, 1 September 1992–31 August 1993.** Kvale, T.J. Toledo Univ., OH (United States). Dept. of Physics and Astronomy. [1993]. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG05-88ER13971. Order Number DE93013863. Source: OSTI; NTIS; INIS; GPO Dep.

This Technical Progress Report describes the progress made on the research objectives during the past twelve months. This research project is designed to provide measurements of various scattering processes which occur in H^- collisions with atomic (specifically, noble gas and atomic hydrogen) targets at intermediate energies. These processes include elastic scattering, single- and double-electron detachment, and target excitation/ionization. For the elastic and target inelastic processes where H^- is scattered intact, the experimental technique of Ion Energy-Loss Spectroscopy (IELS) will be employed to identify the final target state(s). In most of the above processes, cross sections are unknown both experimentally and theoretically. The measurements in progress will provide either experimentally determined cross sections or set upper limits to those cross sections. In either case, these measurements will be stringent tests of our understanding in energetic negative ion - atom collisions. In addition secondary negative particle emission yields for H^0 on Cu in the 3 to 50 keV range are shown.

25184 (DOE/ER/14263–1) **[Experiments in ultracold collisions]: Progress report, May 1, 1992–November 1, 1992.** Gould, P.L. Connecticut Univ., Storrs, CT (United States). 1992. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-92ER14263. Order Number DE93012110. Source: OSTI; NTIS; GPO Dep.

Conditions in an ultracold magneto-optical laser trap were studied; the trap is being used to investigate collisions of ^{85}Rb and ^{87}Rb atoms at temperatures below 1 mK. The ballistic time-of-flight method was used to determine the temperature. It was found that the temperature increases monotonically with laser intensity; this means that the temperature dependence of various collisional processes can probably be measured. The trap size was found to be independent of laser intensity, except at the lowest intensities.

25185 (INDC(NDS)–202/GA, pp. 22-24) **The JAERI activities on A and M data for fusion. Status report, November 1987.** Nakai, Yohta (Japan Atomic Energy Research Inst. Tokai, Ibaraki (Japan). Dept. of Physics); Shirai, Toshizo. International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Feb 1988. (CONF-8711366–: 7. meeting of the Atomic and Molecular Data Centre Network, Oak Ridge, TN (United States), 9-11 Nov 1987). In *7. meeting of the Atomic and Molecular Data Centre Network, Oak Ridge National Laboratory, Oak Ridge, TN, 9-11 November 1987: Suumary report.* [54p.] Order Number DE93626599. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. 7 refs. DATA COMPILATION/electron capture; DATA COMPILATION/electron loss; DATA COMPILATION/spectra; ELECTRON CAPTURE/total cross sections; ELECTRON LOSS/total cross sections; ATOM-ATOM COLLISIONS; ATOM-MOLECULE COLLISIONS; SPECTRA; HYDROGEN; HYDROGEN IONS; INFORMATION SYSTEMS; ION-ATOM COLLISIONS; ION-MOLECULE COLLISIONS; JAERI; METALS; MULTICHARGED IONS; PROGRESS REPORT

25186 (INDC(NDS)–202/GA, pp. 54) **Progress and future activities at the Joint Institute for Laboratory Astrophysics (JILA).** International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Feb 1988. (CONF-8711366–: 7. meeting of the Atomic and Molecular Data Centre Network, Oak Ridge, TN (United States), 9-11 Nov 1987). In *7. meeting of the Atomic and Molecular Data Centre Network, Oak Ridge National Laboratory, Oak Ridge, TN, 9-11 November 1987: Summary report.* [54p.] Order Number DE93626599. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. DISSOCIATION/cross sections; DISSOCIATION/data compilation; PHOTOIONIZATION/cross sections; PHOTOIONIZATION/data compilation; DISSOCIATION; ELECTRON-ATOM COLLISIONS; ELECTRON-MOLECULE COLLISIONS; PHOTOIONIZATION; PROGRESS REPORT

25187 (INDC(NDS)–217/GZ) **Atomic and molecular data for radiotherapy: Summary report of 1. research co-ordination meeting, Vienna, 30 January - 2 February.** Okamoto, K. (International Atomic Energy Agency, Vienna (Austria). Nuclear Data Section). International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Mar 1989. [54p.] (CONF-8901232–: 1. research co-ordination meeting on atomic and molecular data for radiotherapy, Vienna (Austria), 30 Jan - 2 feb 1989). Order Number DE93626073. Source: OSTI; NTIS (US Sales Only); INIS.

This is the summary report of the First Research Co-ordination Meeting of the IAEA Co-ordinated Research Programme (CRP) on Atomic and Molecular Data for Radiotherapy, convened by the IAEA Nuclear Data Section in Vienna, from 30 January to 2 February 1989. The main objectives of the CRP are to generate, compile and evaluate the important atomic and molecular data relevant to radiotherapy. (author). 38 refs, 7 figs, 10 tabs.

25188 (INDC(NDS)–253/N2, pp. 20-28) **Recommended data base for electron impact excitation and ionization of helium atoms.** Heer, F.J. de; Kato, T.; Kingstom, A.E.; Janev, R.K. International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Jan 1992. (CONF-9106429–: IAEA consultants' meeting on He-beam data base for alpha particle diagnostics fo fusion plasmas, Vienna (Austria), 3-5 Jun 1991). In *IAEA consultants' meeting on He-beam data base for alpha particle diagnostics of fusion plasmas: Summary report.* [55p.] Order Number DE93626995. Source: OSTI; NTIS (US Sales Only); INIS.

In the context of helium-beam attenuation in plasmas and fusion alpha particle diagnostics, a database of cross sections for electron impact excitation and ionization of helium atoms is required. This report is issued by the Working Group that aims to arrive at a recommended database of this kind. Due to the large variety of collision processes that need to be considered the Working Group could not arrive at a final recommendation. However, it appears that sufficient knowledge is available for application in calculations of helium beam stopping cross sections in a fusion plasma. Several reviews useful for helium beam stopping and diagnostics in fusion plasmas are listed. Various electron-collision channels for singlet excitation from the helium ground state as well as triplet excitation from the helium ground state are listed together with the energy range, the method, reference, and the accuracy of the cross-section data. Also discussed and referenced are data on electron-collision induced transitions between excited helium states and electron-collision induced ionization, from the ground state as well as from excited states of helium.

25189 (INDC(NDS)–253/N2, pp. 29-48) **Database for collision processes involving helium atoms and ions.** Fritsch, W.; Gayet, R.; Gilbody, H.B.; Olson, R.E.; Schartner, K. International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Jan 1992. (CONF-9106429–: IAEA consultants' meeting on He-beam data base for alpha particle diagnostics fo fusion plasmas, Vienna (Austria), 3-5 Jun 1991). In *IAEA consultants' meeting on He-beam data base for alpha particle diagnostics of fusion plasmas: Summary report.* [55p.] Order Number DE93626995. Source: OSTI; NTIS (US Sales Only); INIS.

In this Working Group Report the available data on cross sections for collisions of protons and (plasma) impurity ions with ground state helium atoms, charge transfer and ionization due to collisions between helium ions and other ions, and collisions involving excited helium atoms are discussed for the energy range of

10 - 1000 keV/u important for alpha particle diagnostics of magnetic confinement plasmas. 41 refs, 2 figs, 2 tabs.

25190 (INDC(NDS)–254, pp. 9-12) **Recommended data for electron impact excitation and ionisation of Be^{q+} and B^{q+} ions.** Berrington, K.; Clark, R.E.H.; Moores, D.L. International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Sep 1991. (CONF-9106430–: IAEA consultants' meeting on atomic data base for Be and B, Vienna (Austria), 10-12 Jun 1991). In *IAEA consultants' meeting on atomic data base for Be and B: Summary report.* [36p.] Order Number DE93626996. Source: OSTI; NTIS (US Sales Only); INIS.

This Working Group Report comments on the available data for electron impact excitation and ionization of beryllium and boron ions, discussing separately the hydrogen-like, helium-like, lithium-like, beryllium-like, and boron-like ions. 28 refs.

25191 (INDC(NDS)–254, pp. 13-22) **Collisions of Be^{q+} and B^{q+} ions with H, H_2 and He.** Phaneuf, R.A.; Janev, R.K.; Tawara, H.; Kimura, M.; Krstic, P.S.; Peach, G.; Mazing, M.A. International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Sep 1991. (CONF-9106430–: IAEA consultants' meeting on atomic data base for Be and B, Vienna (Austria), 10-12 Jun 1991). In *IAEA consultants' meeting on atomic data base for Be and B: Summary report.* [36p.] Order Number DE93626996. Source: OSTI; NTIS (US Sales Only); INIS.

This Working Group Report discusses the available data on cross sections for collisions of beryllium ions and boron ions with atomic and molecular hydrogen and helium for the purpose of applications for plasma diagnostics and modelling of the plasma edge for low energies, and for plasma diagnostics and energy deposition for high energies. In particular, charge exchange, excitation, ionization and two-electron processes are discussed. 43 refs, 1 tab.

6644 Experimentally Derived Information On Atomic and Molecular Properties

Refer also to citation(s) 25263, 25284

25192 (BNL–48611) **Dynamics of dissociation versus ionization in strong laser fields.** DiMauro, L.F.; Yang, B. Brookhaven National Lab., Upton, NY (United States). [1993]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-930184–2: 3. SILAP conference, Hansui (Belgium), 8-14 Jan 1993). Order Number DE93009261. Source: OSTI; NTIS; INIS; GPO Dep.

In this paper, experimental results are presented which clearly demonstrate the effectiveness that an external field has in altering the dissociation dynamics. The experiment examines the strong-field dissociation dynamics of molecular hydrogen ions and its deuterated isotopes. These studies involve multiphoton excitation in the intensity regime of 10^{11-14} W/cm^2 with the fundamental and second harmonic of a ND:YAG or ND:YLF laser system. Measurements include energy resolved electron and mass spectroscopy which provide useful probes in elucidating the interaction dynamics predicted by existing models. The example this in this paper, examines the strong-field dissociation of H_2^+, HD^+, and D_2^+ at green (0.5 μm) and (1 μm) frequencies. The diatomic ions are formed via multiphonon ionization of the neutral precursor which is physically separable from the dissociation process. This study provides the first observation of the dynamics associated with the above threshold dissociation (ATD) process and analogies will be made with the more familiar above threshold ionization (ATI) phenomenon.

25193 (BNL–48940) **A search for strong-field direct two electron ionization using coincidence spectroscopy.** Agostini, P. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Recherches sur les Surfaces et de l'Irradiation de la Matiere); Mevel, E.; Breger, P.; Walker, B.; Yang, B.; DiMauro, L.F. Brookhaven National Lab., Upton, NY (United States). [1993]. 5p. Sponsored by USDOE, Washington, DC (United States); North Atlantic Treaty Organization, Brussels (Belgium); European Economic Community, Brussels (Belgium). DOE Contract AC02-76CH00016. Contract SC1-0103C;Contract SA.5-2-05(RG910678). (CONF-9303119–2: 5. short wavelength: physics with intense laser pulses, San Diego, CA (United States), 29-31 Mar 1993). Order Number DE93013435. Source: OSTI; NTIS; INIS; GPO Dep.

We report on our program in detecting two-electron ionization using electron-electron and electron-ion coincidence measurements. The coincidence techniques have been applied to the multiphoton ionization (MPI) of xenon atoms with 0.527 μm excitation. The results show that direct two electron ionization is not occurring which is in variance with an earlier report. We also present a polarization study on the MPI of helium at 0.62 μm and discuss these results in context of existing models.

25194 (CONF-870789–5) **Discussion of the role of many-electron motions in multiphoton ionization and excitation.** Boyer, K. (Illinois Univ., Chicago, IL (United States). Lab. for Atomic, Molecular, and Radiation Physics); Jara, H.; Luk, T.S.; McIntyre, I.A.; McPherson, A.; Rosman, R.; Solem, J.C.; Rhodes, C.K.; Szoeke, A. Lawrence Livermore National Lab., CA (United States). [1987]. 12p. Sponsored by USDOE, Washington, DC (United States); Department of Defense, Washington, DC (United States); National Science Foundation, Washington, DC (United States). DOE Contract W-7405-ENG-36. From 4. international conference on multiphoton processes (ICOMP IV); Boulder, CO (United States); 13-17 Jul 1987. Order Number DE93011367. Source: OSTI; NTIS; GPO Dep.

The character of many-electron interactions in atoms is examined in relation to a possible role for these couplings in multiphoton processes. It is found that they provide a natural mechanism which can produce both (1) anomalously rapid rates of multiphoton ionization and (2) the direct production of electronically excited ionic species. Furthermore, it is determined that these two phenomena should be strongly correlated. On this basis, the experimental data concerning multiphoton ionization and the generation of fluorescence give evidence for a significant role for two-electron amplitudes in the heavy rare gases. For subpicosecond irradiation at 248 nm, the data indicate that the multi-electron processes become important above an intensity of $\sim 10^{14}$ W cm^{-2}, particularly for xenon. The trend exhibited by these findings suggests that multi-electron processes will become increasingly prominent at intensities above $\sim 10^{16}$ W cm^{-2}.

25195 (FEI–2173) **Effect of oxygen concentration and ordering on vanadium-oxygen alloy vibrational spectra: Frequency spectra calculation.** Sumin, V.V.; Danilkin, S.A.; Minaev, V.P. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk (Russian Federation). Fiziko-Ehnergeticheskij Inst. 1991. [19p.] (In Russian). Order Number DE93627003. Source: OSTI; NTIS (US Sales Only); INIS.

The calculations of disordered interstitial solid solution vanadium - oxygen vibrational spectra are presented. The qualitative description of vanadium atom spectrum deformation caused by oxygen was obtained in frame of virtual crystal approximation. The interatomic vanadium - oxygen potential is presented. The oxygen atoms vibrational spectra for different oxygen contents were calculated using the computer simulation method. The concentration dependence of oxygen vibrational band widths and the oxygen atoms ordering effects are discussed. 17 refs.; 5 figs.; 3 tabs.

25196 (LA–93009869) **Experimental observations of resistive cooling in a Penning trap.** Cornford, S.L. Los Alamos National Lab., NM (United States). May 1992. 117p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. Order Number DE93009869. Source: OSTI; NTIS; GPO Dep.

Thesis submitted by S.L. Cornford to Texas A&M University, College Station.

Large numbers of antiprotons cooled by LEAR(CERN) to 2 MeV and subsequently cooled to a few hundred eV must be brought to much lower density velocity in order to measure their gravitational acceleration by the earth. A sufficient number of antiprotons near an end-point speed of 5 m/s will be available if about 10^5 $\bar{p}$s per extraction are in a thermal distribution with an average energy of about 10 K. Passive ("resistive") cooling is a well understood and previously demonstrated method which may be extended to achieve such a velocity distribution. This research demonstrates the viability of such a cooling method. By using a superconducting resonant coil with a 4 K Penning trap, resistive cooling of He^- ions

is observed, with a minimum cooling time constant of $1.8_{-0.2}{}^{-0.5}$ seconds. This value translates into an H^+ or $\bar{p}$ cooling time constant of ~0.5 seconds.

25197 (LA-SUB–93-123) **Measurements of electron densities and collision frequencies in high power microwave breakdown plasmas in low pressure air: Final report.** Stalder, K.R. (SRI International, Menlo Park, CA (United States)); Eckstrom, D.J. Los Alamos National Lab., NM (United States); SRI International, Menlo Park, CA (United States). Mar 1989. 18p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract W-7405-ENG-36. Order Number DE93012881. Source: OSTI; NTIS (US Sales Only); GPO Dep.

We report Measurements of the electron density and collision frequency in high power microwave discharges in low pressure air. A microwave interferometer operated at 9.59 GHz was used for these measurements. The plasmas were formed in an evacuable tank by breakdown of low pressure air in the constructive interference regions where 2.86 GHz microwaves reflected from an inclined plate. The pressure range was from 0.01 Torr to 3.0 Torr. The results show that the electron density rose quickly, consistent with ionization rates predicted by theory, then became overdense (for the 2.86 GHz microwaves) and decayed slowly after the high power microwaves were turned off. The electron density decayed with a rate of proportional to pressure. The electron collision frequency ranged from 1×10^{10} sec^{-1} to 2×10^{11} sec^{-1}, and did not scale linearly with pressure. Anomalously high attenuation was observed, and was responsible for these results. The sources of the high attenuation most likely were refractive losses and diffractive losses from the structured plasma.

25198 (UCRL-JC–110145) **Time-dependent dynamics of an atom in an intense laser field.** Kulander, K.C.; Krause, J.L.; Schafer, K.J.; Allendorf, S.W.; Crane, J.K.; Budil, K.S.; Perry, M.D. Lawrence Livermore National Lab., CA (United States). 27 Mar 1992. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9203238–2: North Atlantic Treaty Organization (NATO) advanced research workshop on time dependent quantum molecular dynamics: experiments and theory, Snowbird, UT (United States), 30 Mar - 3 apr 1992). Order Number DE93012572. Source: OSTI; NTIS; GPO Dep.

A laser excited atom emits both electrons and photons. A method involving the explicit solution of the time-dependent Schroedinger equation is used to determine the ionization and photoemission rates for Kr in a 532 nm laser at intensities in the range from 10^{12}–10^{14} W/cm^2. The photon spectrum is dominated by strong peaks at odd multiples of the driving frequency. This is called harmonic generation. The results are compared to obtained experimental rates. Also electron angular distributions and spin-orbit branching ratios for the ion are given for the case of excitation by a 1064 nm laser and its second harmonic. The dependence of the final state distributions on the relative phase between the lasers is presented.

6645 Special Atoms and Molecules

Refer also to citation(s) 25158, 25182, 25233

25199 (CONF-9209221–, pp. 327-334) **Formation of positronium compounds in slow positron beams.** Schrader, D.M. (Marquette Univ., Milwaukee, WI (US)). Oak Ridge National Lab., TN (United States). Apr 1993. From Department of Energy (DOE) task force meeting workshop on the application of positron spectroscopy to materials sciences; Miranch Mirage, CA (United States); 9-11 Sep 1992. In *DOE workshop meeting on the application of positron spectroscopy to materials sciences: Proceedings.* 395p. Order Number DE93012784. Source: OSTI; NTIS.

The formation of stable positronium compounds in rearrangement collisions of positrons and molecules is considered. The discussion focuses on energetics and quantum mechanics, with emphasis being given to the role of the intermediate resonance state. The calculation of the cross section and the role of spin is considered. Some conjectures concerning possible future work are given.

6650 Physics of Condensed Matter

Refer also to citation(s) 24246, 25195

25200 (DOE/ER/14181–1) **Theoretical treatment of the bulk and surface properties of fluids containing long, flexible molecules.** North Carolina State Univ., Raleigh, NC (United States). [1993]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG05-91ER14181. Order Number DE93015560. Source: OSTI; NTIS; GPO Dep.

Purpose is to develop an equation of state for predicting the thermodynamic properties of fluids containing chain-like molecules ranging from alkanes to polymers. Foundation of this work is the Generalized Flory Dimer (GFD) theory. GFD is extended to square-well chain mixtures. The second virial coefficient has been evaluated for hard-chain and square-well chain fluids using a Monte Carlo approach. The polymer RISM theory was used to determine the segment-segment radial distributrion function for hard chain fluids. Monte Carlo simulations are being performed of the self-diffusion coeffient, shear and longitudinal viscosities, and thermal conductivity for hard chain fluids. (DLC)

25201 (DOE/ER/45133–5) **[Study of multicomponent diffusion and transport phenomena]: Progress report.** Purdue Univ., Lafayette, IN (United States). School of Materials Engineering. [1993]. 21p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-84ER45133. Order Number DE93015095. Source: OSTI; NTIS; GPO Dep.

The major activities in this period are the percolation threshold in electronic conduction in β-alumina type solid electrolytes, mixed alkali effects in ion conducting binary glasses, chemical diffusion problems, semiconductors, and relaxation process in diffusion. The last one constitutes the recent progress.

25202 (LA-UR–93-1296) **Quantum Monte Carlo by message passing.** Bonca, J.; Gubernatis, J.E. Los Alamos National Lab., NM (United States). [1993]. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9302112–2: Madi Gras conference on concurrent computing in the physical sciences, Baton Rouge, LA (United States), 18-20 Feb 1993). Order Number DE93012645. Source: OSTI; NTIS; GPO Dep.

We summarize results of quantum Monte Carlo simulations of the degenerate single-impurity Anderson model using the impurity algorithm of Hirsch and Fye. Using methods of Bayesian statistical inference, coupled with the principle of maximum entropy, we extracted the single-particle spectral density from the imaginary-time Green's function. The variations of resulting spectral densities with model parameters agree qualitatively with the spectral densities predicted by NCA calculations. All the simulations were performed on a cluster of 16 IBM R6000/560 workstations under the control of the message-passing software PVM. We described the trivial parallelization of our quantum Monte Carlo code both for the cluster and the CM-5 computer. Other issues for effective parallelization of the impurity algorithm are also discussed.

25203 (SAND–92-1716C) **An improved material interface reconstruction algorithm for Eulerian codes.** Bell, R.L. (Amparo Corp., Albuquerque, NM (United States)); Hertel, E.S. Sandia National Labs., Albuquerque, NM (United States). [1992]. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-9211128–7: 1992 nuclear explosives code developers conference, Sunnyvale, CA (United States), 2-6 Nov 1992). Order Number DE93011679. Source: OSTI; NTIS (US Sales Only); GPO Dep.

In general, shock wave physics codes can be divided into two major categories: (1) Lagrangian codes and (2) Eulerian codes. (A third category, Arbitrary Lagrangian Eulerian (ALE) codes, allows the computational mesh to move with the material until some measure of mesh distortion is achieved, then the mesh is redefined and the materials are allowed to flow through the mesh, as in an Eulerian calculation.) With Lagrangian codes the cell boundaries also form the interface between different materials in a calculation. In an Eulerian calculation, the cell boundaries may initially form the interface between materials, but as the calculation proceeds and materials flow through the mesh, material interfaces will not lie on

cell boundaries. Knowledge about the location of materials in a mixed material cell is necessary to determine the correct advection of materials from a mixed cell as an Eulerian (or ALE) code calculation progresses through time. Using a material interface reconstruction algorithm that is unable to accurately determine material interface locations is analogous to running a one material problem using a first order accurate differencing scheme. The material interface reconstruction method described here is an extension to the method developed by D.L. Youngs. Youngs' method uses volume fraction information from the donor cell and all surrounding cells to determine the orientation and location of planes dividing materials from one another in a mixed material cell. Many codes use the popular Simple Line.

25204 (UCRL-ID–111487) **Computational procedures for determining parameters in Ramberg-Osgood elastoplastic model based on modulus and damping versus strain.** Ueng, Tzou-Shin; Chen, Jian-Chu. Lawrence Livermore National Lab., CA (United States). Jul 1992. 18p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE93013309. Source: OSTI; NTIS; GPO Dep.

A computer code, RAMBO, is developed for obtaining the values of parameters in the Ramberg-Osgood elastoplastic model based on data of shear modulus and damping ratio at various shear strains. The basis and procedures for finding the parameters for the best fit of the data or relations defining modulus and damping ratios versus shear strain are given in this report. The Ramberg-Osgood relationship is rearranged so that the results can best fit data of both modulus and damping ratio. Constraints of data in the model are also discussed.

25205 (UCRL-JC–111904) **Monte Carlo simulation of the OCP freezing transition.** DeWitt, H.E. (Lawrence Livermore National Lab., CA (United States)); Slattery, W.L.; Yang, Juxing. Lawrence Livermore National Lab., CA (United States). Sep 1992. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9208135–6: International conference on the physics of strongly coupled plasmas, Rochester, NY (United States), 17-21 Aug 1992). Order Number DE93013039. Source: OSTI; NTIS; INIS; GPO Dep.

The One Component Plasma (OCP) in three dimensions is a system of classical point charges moving in a fixed uniform neutralizing background. In nature the OCP is a rough approximation of the conditions in a white dwarf star in which one has fully ionized nuclei such as carbon, oxygen, and smaller amounts of heavier elements up to iron all moving in a nearly uniform background provided by relativistically degenerate electrons. The OCP is also a mathematical limiting model for a non-neutral plasma of ions in a Penning trap and cooled to strongly coupled conditions. Similarly, a collection of charge colloidal suspensions in water can exhibit the Coulomb freezing behavior of the OCP. A single dimensionless parameter, Γ is sufficient to describe the system. For very weak coupling, $\Gamma \ll 1$, the thermodynamic properties of the OCP are given rigorously by the Debye-Huckel theory. This paper reports on Monte Carlo simulation of the freezing of the OCP from a random start for particle numbers ranging from 500 to 2000. In one case the authors obtained a perfect bcc lattice, but in most cases the final state would be an imperfect crystal or two different microcrystals, fcc and bcc, growing into each other. With a cluster analysis program the authors looked at the formation of nucleating clusters, and followed the actual freezing process. Roughly 80 particles are needed in a cluster before it starts to grow rapidly and freeze.

6651 Nuclear Techniques In Condensed Matter Physics

Refer also to citation(s) 23898, 23899, 23900, 23989, 23992, 24032

25206 (BNL–48628) **A new matrix for the "ageless" 21.6-keV ^{151}Eu nuclear gamma ray Moessbauer source.** Wynter, C.I. (Nassau Community College, Garden City, NY (United States). Dept. of Chemistry); Haustein, P.E.; Stadelmaier, H.; Thorpe, A.; Spijkerman, J.J.; Nowik, I. Brookhaven National Lab., Upton, NY (United States). [1993]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-930195–1: 2. Nassau Moessbauer conference, Garden City, NY (United States), 8 Jan 1993). Order Number DE93009795. Source: OSTI; NTIS; GPO Dep.

Moessbauer spectroscopy has been used over the past two decades to advance the study of europium compounds and alloys, primarily utilizing the 21.6-kev gamma ray emitted from beta decaying ^{151}Sm. This isotope, which has a 87 year half-life, has been used in either a samarium fluoride (SmF^3) or samarium oxide (Sm_2O_3) matrix. We now report a study involving, europium oxalate decahydrate ($Eu2(C_2O_4)\cdot 10H_2O$), europium fluoride EuF_3 and $EuBe_{13}$ as absorbers at known thicknesses. Our data supports the view that $Sm_2(C_2O_4)_3\cdot H_2O$ will provide a better source matrix than either the fluoride or oxide due to the narrower linewidth and comparable "f" factor to $^{151}SmF_3$.

25207 (CEA-CONF–11233) **Positron annihilation in electron irradiated GaAs: atomic structure and charge state of the defects.** Corbel, C. (Institut National des Sciences et Techniques Nucleaires (INSTN), Centre d'Etudes de Saclay, 91 - Gif-sur-Yvette (France)); Pierre, F.; Moser, P.; Hautojarvi, P.; Saarinen, K. Institut National des Sciences et Techniques Nucleaires (INSTN), Centre d'Etudes de Saclay, 91 - Gif-sur-Yvette (France). 1991. [6p.] (CONF-9107146–: 16. international conference on defects in semiconductors, Bethlehem, PA (United States), 22-26 Jul 1991). Order Number DE93627276. Source: OSTI; NTIS (US Sales Only); INIS.

Positron lifetime measurements show that electron irradiation produces negative vacancies and negative ions at 20 K in semi-insulating GaAs. The vacancies anneal between 77-500 K with a sharp stage in the range 270-370 K. The ions anneal at high temperature above 450 K. The negative ions are identified to isolated gallium antisites. The negative vacancies are identified to gallium vacancies either isolated or involved in negatively-charged complexes. The introduction rate of the gallium antisites is estimated to be 1.8 ± 0.4 cm^{-1} after 1.5 MeV electron irradiation at 20 K.

25208 (CEA-CONF–11234) **Vacancy in the metastable state of the EL2 defect in GaAs.** Corbel, C. (Institut National des Sciences et Techniques Nucleaires (INSTN), Centre d'Etudes de Saclay, 91 - Gif-sur-Yvette (France)); Leberre, C.; Hautojarvi, P.; Saarinen, K.; Liszkay, L. Institut National des Sciences et Techniques Nucleaires (INSTN), Centre d'Etudes de Saclay, 91 - Gif-sur-Yvette (France). 1991. [5p.] (CONF-9107146–: 16. international conference on defects in semiconductors, Bethlehem, PA (United States), 22-26 Jul 1991). Order Number DE93627277. Source: OSTI; NTIS (US Sales Only); INIS.

Photoquenching of the EL2 defects in semi-insulating GaAs increases positron trapping at vacancies. This is associated to a metastable vacancy having the following properties: it recovers as the metastable state of EL2, its concentration correlates with that of EL2, and its charge is negative. We conclude that the metastable vacancy is involved in the atomic configuration of the metastable state of the EL2 defect.

25209 (CONF-930822–3) **High resolution microscopy of ceramic surfaces.** Bentley, J. Oak Ridge National Lab., TN (United States). [1993]. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From Annual meeting of the Electron Microscopy Society of America; Cincinnati, OH (United States); 1-6 Aug 1993. Order Number DE93013205. Source: OSTI; NTIS; GPO Dep.

The characterization of ceramic surfaces plays an important role in understanding a wide variety of properties such as fracture, wear, crack initiation, oxidation, sintering, and thin film growth on substrates. Three major microscopies are employed to obtain nanometer-scale resolution of ceramic surfaces: scanning electron microscopy (SEM), (scanning) transmission electron microscopy (STEM or TEM) especially in the glancingincidence reflection modes, and scanning tip microscopies - most notably atomic force microscopy (AFM). Each technique has its own set of characteristics, advantages, and disadvantages and is usually complementary to the others.

25210 (DOE/ER/45163–33) **X-ray and γ-ray spectroscopy of solids under pressure: Annual technical progress report, October 1990–October 1993.** Ingalls, R.L. Washington Univ., Seattle,

WA (United States). Dept. of Physics. 30 Apr 1993. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG06-84ER45163. Order Number DE93014847. Source: OSTI; NTIS; GPO Dep.

The following studies are described that were either completed during this 3-year period or are well underway: XAFS study of pressure-induced transition in Rb-W bronze ($Rb_{0.31}WO_3$); XAFS study of bcc-hcp transition in Fe; XAFS search for valence change in thallium perhenate ($TlReO_4$) at high pressure; XANES analysis of alkali halides; pair potentials in alkali halides studied via EXAFS; EXAFS determination of bond angles in ReO_3; XAFS study of mixed-valence transition in SmSe; Moessbauer studies of Fe hydride at high pressure; and Moessbauer and x-ray studies of Fe silicate spinel at high pressure. (DLC)

25211 (DOE/ER/45233–8) **Application of spin-sensitive electron spectroscopies to investigations of electronic and magnetic properties of solid surfaces and epitaxial systems: Progress report, 1 November 1992–31 October 1993.** Walters, G.K.; Dunning, F.B. Rice Univ., Houston, TX (United States). Apr 1993. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG05-86ER45233. Order Number DE93015079. Source: OSTI; NTIS; INIS; GPO Dep.

Research during this year focused on angular dependence of polarization of electrons backscattered from metallic surfaces, as a function of energy loss, using spin-polarized electron energy loss spectroscopy (SPEELS), and on dynamics of metastable He(2^3S) deexcitation at Xe-covered metallic surfaces using spin-polarized metastable deexcitation spectroscopy (SPMDS). In the SPEELS study, the data from Au, Ag, Mo, and Fe surfaces suggest that all inelastically scattered electrons underwent small-angle inelastic scattering either preceded or followed by large-angle elastic scattering that redirects the incident electron away from the target. The SPMDS study was extended from other gases to include rare=gas adsorbates on Cu(100) and Au(100) surfaces; the spectra from the Xe- metal systems are unlike hose from other systems and may provide new insights into metastable-surface interactions. (DLC)

25212 (DOE/FTR–93013655) **Participation in the 3rd international conference on nuclear microprobe technology and applications held in Uppsala, Sweden: Foreign trip report, June 3–13, 1992.** Doyle, B.L. Sandia National Labs., Albuquerque, NM (United States). 1992. 37p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. Order Number DE93013655. Source: OSTI; NTIS (US Sales Only); GPO Dep.

I presented a talk titled "Ion Beam Induced Charge Collection (IBICC) microscopy of ICs: Relation to Single Event Upsets (SEUs)" at the Microbeam Conference in Uppsala. A similar invited seminar was presented at the University of Lund. This conference is held every 2 1/2 years and is a forum for scientists developing and utilizing nuclear microprobes (i.e., scanned MeV microfocused ion beam systems). R&D on the Sandia nuclear microbeam remains among the most innovative in the world, and new microscopic analyses of both the ion-induced malfunction and active volumes of integrated circuits were presented at the meeting. Following our invention of single event upset imaging, ~6 other groups are now exploring this and other nuclear microscopic studies of Ics. In addition to attending the meeting, I also visited the nuclear microprobe laboratories at Uppsala and Lund University and also the proton radiotherapy laboratory at Uppsala.

25213 (FRCEA-TH–378) **Investigation of new NMR methods for structural and dynamic studies in the liquid state.** Desvaux, H. CEA Centre d'Etudes de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Recherche sur l'Etat Condense, les Atomes et les Molecules; Paris-6 Univ., 75 (France). 21 Jan 1993. [141p.] (In French). Order Number DE93627278. Source: OSTI; NTIS (US Sales Only); INIS.

After a short presentation of the NMR fundements, three new methods of spin -lattice relaxation in liquids are reported. (1) The method consists of measuring the steady-state nuclear magnetization under strong off-resonance rf irradiation as a function of the angle θ between external field and effective field. For purely dipolar relaxation between homonuclear spins under isotropic Brownian molecular rotation, this variation yields the value of the local correlation time. A departure from the theoretical shape reveals the existence of complex motions or complex relaxation mechanisms. These results have been verified by experimental illustrations. Some numerical simulations have been performed for studying the effects of the distribution of chemical shift and for studying the coherence of the local correlation time concept. (2) The improvements of a modified ROESY experiment are discussed. The use of a time-modulated strong off-resonances rf irradiation permits to suppress totally the problems of the NOESY (suppression of cross-relaxation peaks for molecules where $\omega\tau_c \simeq 1.1$) and of the ROESY (HOHAHA transfer and angular dispersion due to the chemical shift distribution). The angle θ defined previously can be used as a constraint: either to obtain a ratio of the cross over direct dipolar relaxation rates independent on the correlation time value, or to observe the sole chemical exchange. (3) The difference of the relaxation rates of the coherences at zero and two quanta is always exactly the cross relaxation rates measured by the NOESY experiment. The experimental illustration is presented.

25214 (FRNC-TH–3726) **Study of dynamic polarization in low fields of free radicals in solution. Application to NMR magnetometry.** Pellerej, M.P. Grenoble-1 Univ., 38 (France). Mar 1992. [230p.] (In French). Order Number DE93627279. Source: OSTI; NTIS (US Sales Only); INIS.

This thesis is a theoretical and experimental study of performance in dynamic polarization of new radicals based on phosphorus for low field NMR magnetometry. Radical-solvent pairs are selected from a theoretical analysis. Anisotropic hyperfine coupling importance in the ESR line broadening for phosphoreted radicals is evidenced. Various systems are investigated and interpreted by numerical models. Phosphoranyle radicals in solution in tetrahydrofuran are the most promising. Electron-proton coupling is investigated leading to the development of a NMR relaxometer with a free precession in the terrestrial magnetic field.

25215 (LA-UR–93-1519) **Rietveld refinement of magnetic structures from pulsed-neutron-source powder-diffraction data.** Robinson, R.A.; Lawson, A.C.; Larson, A.C.; Von Dreele, R.B.; Goldstone, J.A. Los Alamos National Lab., NM (United States). [1993]. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9305177–2: 12. International collaboration of advanced neutron sources meeting (ICANS), Abingdon (United Kingdom), 24-28 May 1993). Order Number DE93012740. Source: OSTI; NTIS; GPO Dep.

The General Structure Analysis System, GSAS, has recently been modified to include magnetic neutron-scattering cross-sections. Low-temperature diffraction data have been taken on the hexagonal noncollinear antiferromagnet UPdSn on both the HIPD and the NPD powder diffractometers at LANSCE. The low-resolution data reveal that the magnetic structure has orthorhombic symmetry (magnetic space group P_c112_1) between 25K and 40K, and monoclinic symmetry (magnetic space group P_c112_1) below 25K. The high-resolution data reveal that there are structural distortions with corresponding symmetry changes in each of these phases, to give chemical space groups $Cmc2_1$ and $P2_1$ respectively, while the paramagnetic phase above 40K has space group $P6_3mc$. Using GSAS, we have refined data sets from both diffractometers simultaneously, including both magnetic and structural cross-sections. Magnetoelastic coefficients for the distortions have been extracted and we have determined the sip of the coupling between the structural monoclinicity and the magnetic monoclinicity. The magnetic results from Rietveld refinement are in good agreement with model fitting to the integrated intensities of seven independent magnetic reflections and these, in turn, agree with measurements made on the same sample using the constant-wavelength reactor technique. Our results therefore validate, to some level, both the technique of using spallation sources for complicated magnetic structures and the specifics of the GSAS Rietveld code.

25216 (ORNL/FTR–4366) **[Resonant nuclear scattering seminar presentations]: Foreign trip report, August 15–25, 1992.** Tischler, J.Z. Oak Ridge National Lab., TN (United States). 9 Sep 1992. 13p. Sponsored by USDOE, Washington, DC (United

States). DOE Contract AC05-84OR21400. Order Number DE93012408. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The purpose of this trip was to present a paper on applications of resonant nuclear scattering to the International Conference on Anomalous Scattering, Malente, Germany, and to make site visits to the University of Hamburg, Institute for Experimental Physics (II), and the Hamburg Synchrotron Radiation Laboratory (HASYLAB). An important result of the conference was the central role seen for x-ray optics at the new third-generation synchrotron light sources under construction. The site visit to the University of Hamburg Institute for Experimental Physics (II) provided a clear picture of the experimental techniques and future plans in resonant nuclear scattering of the European community. The site visit to the HASYLAB provided a valuable view of the experimental equipment developed there for energy resolved x-ray scattering.

25217 (SAND–93-0812C) **High spatial resolution x-ray microanalysis: Comparison of experiment and incoherent scattering calculations.** Michael, J.R.; Romig, A.D. Jr. Sandia National Labs., Albuquerque, NM (United States). [1993]. 2p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-930822–1: Annual meeting of the Electron Microscopy Society of America, Cincinnati, OH (United States), 1-6 Aug 1993). Order Number DE93011685. Source: OSTI; NTIS; GPO Dep.

Short communication. X RADIATION/microanalysis; SPATIAL RESOLUTION; ELECTRON MICROSCOPY; MONTE CARLO METHOD; INCOHERENT SCATTERING; MICROANALYSIS

25218 (UCRL-CR–111711) **Transmission electron microscopy studies of multilayer structures: Report on work through November 30, 1991.** Stearns, M.B. (Arizona State Univ., Tempe, AZ (United States)). Lawrence Livermore National Lab., CA (United States); Arizona State Univ., Tempe, AZ (United States). Sep 1992. 2p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE93013185. Source: OSTI; NTIS; INIS; GPO Dep.

Short communication. SILICON/transmission electron microscopy; MOLYBDENUM/transmission electron microscopy; RUBIDIUM/transmission electron microscopy; PROGRESS REPORT; LAYERS; SILICON; MOLYBDENUM; RUBIDIUM

25219 (UCRL-JC–111627) **Surface and near-surface atom imaging with photoelectron holography.** Terminello, L.J. (Lawrence Livermore National Lab., CA (United States)); Barton, J.J.; Lapiano-Smith, D.A. Lawrence Livermore National Lab., CA (United States). Jul 1992. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48 ;AC02-76CH00016. (CONF-920735–6: 10. international conference on vacuum ultraviolet radiation physics, Paris (France), 27-31 Jul 1992). Order Number DE93013197. Source: OSTI; NTIS; GPO Dep.

Near-surface atoms from a Cu(001) surface were imaged using 3p photo- electron holograms. The angle-dependent electron diffraction patterns that constitute an electron hologram were Fourier transformed to create a tree dimensional, real-space image of the scattering atoms. We have made use of a multiple-wavenumber, phased summing method to improve the atom imaging capabilities of exerimental photoelectron holography using the Cu(001) proto-type system.

6653 Interactions Between Beams and Condensed Matter

Refer also to citation(s) 23979, 25183, 25390

25220 (IFVE-OP–91-31) **Crystaloptics of high energy γ-beams: 2. On linear and elliptic photon polarization in single crystal.** Maisheev, V.A.; Mikhalev, V.L.; Frolov, A.M. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov (Russian Federation). Inst. Fiziki Vysokikh Ehnergij. 1991. [7p.] (In Russian). Order Number DE93627307. Source: OSTI; NTIS (US Sales Only); INIS.

Two linearly polarized or two elliptic polarized waves with different wave vectors are shown to be the solutions of a dispersion equation for high energy (>or approx.1 GeV) photons in single crystals, oriented in the region of coherent pair production. 4 refs.; 1 fig.

25221 (IHEP-OUNK–89-223) **Efficiency of high energy proton beam deflection with optimal bent single crystal. Temperature dependence of efficiency.** Bavizhev, M.D.; Biryukov, V.M.; Gavrilov, Yu.G. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov (Russian Federation). Inst. Fiziki Vysokikh Ehnergij. 1989. [11p.] (IFVE-OUNK–89-223.). Order Number DE93627308. Source: OSTI; NTIS (US Sales Only); INIS.

An optimal curvature for beam efficiency deflection is derived as a function of the deflection angle. The upper limit on the efficiency dependent on deflection angle is found. The temperature dependence of the efficiency is presented. 7 refs.; 5 figs.

25222 (ORNL/TM–12170) **Determination of channeling perspectives for complex crystal structures.** Allen, W.R. Oak Ridge National Lab., TN (United States). Mar 1993. 27p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93012872. Source: OSTI; NTIS; INIS; GPO Dep.

Specification of the atomic arrangement for axes and planes of high symmetry is essential for crystal alignment using Rutherford backscattering and for studies of the lattice location of impurities in single crystals. By rotation of an inscribed orthogonal coordinate system, a visual image for a given perspective of a crystal structure can be specified. Knowledge of the atomic arrangement permits qualitative channeling perspectives to be visualized and calculation of continuum potentials for channeling. Channeling angular-yield profiles can then be analytically modeled and, subsequently, shadowing by host atoms of positions within the unit cell predicted. Software to calculate transformed atom positions for a channeling perspective in a single crystal are described and illustrated for the spinel crystal structure.

6654 Quantum Physics Aspects of Condensed Matter

25223 (DOE/ER/45406–1) **[Research in two-dimensional critical phenomena and conformal field theory]: Final report.** Rutgers–the State Univ., New Brunswick, NJ (United States). [1990]. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG05-89ER45406. Order Number DE93013972. Source: OSTI; NTIS; GPO Dep.

A very theoretical description is given of research in two- dimensional critical phenomena and conformal field theory. Major progress is reported in the field of fluctuating two-dimensional surfaces. A discretized representation of fluctuating geometry is used where surfaces are represented by triangulations; continuum surfaces are recovered by taking the size of the triangles to zero. One of the central goals of the theory of critical phenomena is to find all possible universality classes of n-dimensional critical phenomena; this goal has been translated into the problem of clasifying all possible scale-invariant euclidean quantum field theories. (RWR)

665410 Superconductivity

Refer also to citation(s) 23927, 23970, 24489

25224 (ANL/MCT/CP–78926) **Development of commercially viable high-T_c Bi-2223 superconductor tapes.** Balachandran, U. (Argonne National Lab., IL (United States). Materials and Components Technology Div.); Youngdahl, C.A.; Haldar, P.; Motowidlo, L.R. Argonne National Lab., IL (United States). Materials and Components Technology Div. Feb 1993. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-930235–1: 5. annual international superconductor applications conference, San Jose, CA (United States), 1-3 Feb 1993). Order Number DE93009966. Source: OSTI; NTIS; GPO Dep.

Long lengths of flexible Ag-clad Bi-2223 Superconductors have been fabricated by the powder-in-tube technique using prereacted, poly-phase, Pb-doped Bi-Sr-Ca-Cu-O powders. At liquid helium (4.2 K) temperature, improved process conditions yielded transport critical current density (J_c) values greater than 10^5 A/cm^2 at zero

field; at liquid nitrogen (77K) temperature, the J_c values of short tape samples exceeded 4×10^4 A/cm$_2$. Rolled tapes are cut into lengths up to 2 - meters long and are used in parallel to fabricate small superconducting pancake coils by the "wind-and-react" technique. The cots are characterized at 77K and 4.2 K. The J_c of the coils are up to 80% of the short, rolled sample result at 77 K. The coils exhibited these results even after being cooled and warmed several times between ambient, 77 K and 4.2 K, indicating their stability following thermal cycling.

25225 (BNL–48570) **Fabrication and test of a superconducting RFQ.** Jain, A. (State Univ. of New York, Stony Brook, NY (United States). Dept. of Physics); Wang, H.; Ben-Zvi, I.; Paul, P.; Noe, J.W.; Lombardi, A. Brookhaven National Lab., Upton, NY (United States). [1992]. 4p. Sponsored by USDOE, Washington, DC (United States); National Science Foundation, Washington, DC (United States). DOE Contract AC02-76CH00016. Grant PHY-8902923. (CONF-9210337–1: 1992 international conference of applications of particle accelerators, Denton, TX (United States), Oct 1992). Order Number DE93010860. Source: OSTI; NTIS; INIS; GPO Dep.

The fabrication and first performance tests of a prototype superconducting radio-frequency quadrupole resonator (SRFQ) are described. The SRFQ operates at 57 MHz and is optimized for a particle velocity of $\beta = 0.033$. It is constructed of copper electroplated with a lead-tin alloy. An accelerating field gradient of 1.25 MV/m was achieved with about 7 watts of helium dissipation. This corresponds to an energy gain of 700 keV per unit charge over the 56 cm overall diameter of the resonator.

25226 (CONF-9209221–, pp. 89-94) **Challenges for positron analysis in materials science.** Howell, R.H. (Lawrence Livermore National Lab., CA (US)). Oak Ridge National Lab., TN (United States). Apr 1993. From Department of Energy (DOE) task force meeting workshop on the application of positron spectroscopy to materials sciences; Miranch Mirage, CA (United States); 9-11 Sep 1992. In *DOE workshop meeting on the application of positron spectroscopy to materials sciences: Proceedings.* 395p. Order Number DE93012784. Source: OSTI; NTIS.

Ever since the realization that positrons thermalize in solid materials and may trap in defected ones every known interaction and annihilation property of positrons has been applied to materials analysis. These include measurement of: the positron lifetime, the angular deviation of the annihilation gamma rays, the materials controlled diffusion and trapping of implanted positrons, spectroscopies of positrons and positronium emitted from surface-vacuum interfaces, and positron analogs of electron experiments such as diffraction and Auger electron emission. At LLNL positron analysis has been integrated into the mainstream materials science program on an equal footing with other competing techniques such as angle resolved photo emission. This integration has resulted in a close coupling of positron results and general program goals. An example of this approach is seen in the results of the LLNL superconducting program where both lifetime and angular correlation measurements have been used in conjunction with transport measurements, crystal growth techniques, and other electronic structure measurements to attack a variety of problems associated with superconducting oxides. In this talk we will outline the relationship of these measurements and results to the general program outline and what role positron measurements are expected to play in future studies. These studies were conducted at LLNL facilities including the LLNL intense positron beam, the two dimensional angular correlation spectrometer, the positron lifetime laboratory and the high density positron trap. We will cover the status and future direction of the several major positron based facilities available at LLNL and the influence of the development of new techniques and other general use facilities.

25227 (CONF-9209221–, pp. 179-196) **Two dimensional ACAR measurements in high-$T_c$materials; recent results and future perspectives.** Smedskjaer, L.C. (Argonne National Lab., IL (US)). Oak Ridge National Lab., TN (United States). Apr 1993. From Department of Energy (DOE) task force meeting workshop on the application of positron spectroscopy to materials sciences; Miranch Mirage, CA (United States); 9-11 Sep 1992. In *DOE workshop meeting on the application of positron spectroscopy to materials sciences: Proceedings.* 395p. Order Number DE93012784. Source: OSTI; NTIS.

Positron Annihilation is a unique tool for materials studies and characterization. It is being extensively used as a concomitant tool for defect characterization, frequently by means of lifetime, Doppler broadening, and slow-beam techniques. A more original motivation for the positron technique is however to gain insight into the electronic structure of materials. In this regard the 2-D ACAR technique is complementary to other techniques such as dHvA and ARPES. The advent of the high-$T_c$superconductors is a strong challenge to the positron field; in the defect area the challenge is to contribute to the understanding of the defect structures, especially with a view to the future applications of the superconductors. The electronic structure field is being challenged to contribute to the comprehension of the electronic structure (e.g., strongly correlated or Fermi liquids). This talk discusses how the positron technique has contributed to the knowledge about the electronic structure. An overview of the two-dimensional angular correlation (2D-ACAR) positron annihilation results for the three fundamental phases of $YBa_2Cu_3O_x$, namely, the normal metal, the superconductor, and the insulator, is presented. Along with the c-axis projected momentum density, the recent results for the a-axis projection as well as the insulating Y123 are discussed. The experimental results are compared and contrasted with the corresponding band theory predictions for this archetypal high-$T_c$superconductor. It is emphasized that a broad consensus has been obtained among several groups concerning the experimental results and interpretations for this and other high-$T_c$materials. It is anticipated that the high-$T_c$and related materials will be of interest in the future. As an example preliminary data for BKB are discussed along with future experiments, for example in the Fullerenes and organic superconductors.

25228 (DOE/FTR–93013656) **[Travel to Japan Atomic Energy Research Institute, Tokai, Japan to observe the second DPC-EX test]: Foreign trip report, July 11–27, 1992.** Takayasu, Makoto. Massachusetts Inst. of Tech., Cambridge, MA (United States). Plasma Fusion Center. 18 Sep 1992. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-91ER54110. Order Number DE93013656. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The second DPC-EX test was performed. The current-sharing temperature and critical-current measurements in DC test indicated that the DPC-EX coil had about 24% degradation of critical current in comparison with that of a single strand at 7 T. The ramp rate limitation in pulsed field operation was revealed. It was generally similar to that of US-DPC; the ramp limitation currents increase with decreasing the ramp rate. However, the limiting currents of one of the double pancakes increased with increasing the ramp rate in the range of the ramp time between 0.5 s and 1.5 s. Fatigue due to pulsed operation was tested. With regard to the instability problem of the DPC-U1 & U2 it was tested to make current distribution among strands uniform by using inductive heaters. The effectiveness of the heates was proved. The DPC series tests has been completed by this EX test.

25229 (RISO-R–628(EN), pp. 206) **Quasi two-dimensional vortex fluctuations in high-T_c superconductors.** Minnhagen, P. (Department of Theoretical Physics, University of Umeaa, Umeaa (Sweden)). Risoe National Lab., Roskilde (Denmark). Physics Dept. May 1992. (CONF-9205342–: Joint Nordic spring meeting '92; 3. Nordic conference on surface science; 6. Nordic symposium on computer simulation; 3. Nordic symposium on superconductivity, Nyborg (Denmark), 7-10 May 1992). In *Proceedings of the joint Nordic spring meeting '92.* [346p.] Order Number DE93624440. Source: OSTI; NTIS; INIS.

Short communication. HIGH-TC SUPERCONDUCTORS/ magnetic flux; COPPER OXIDES; COUPLING; PHASE TRANSFORMATIONS; SUPERLATTICES

665430 Other Topics in Quantum Fluids and Solids

25230 (LA-UR–93-1414) **Similarity of the leading contributions to the self-energy and the thermodynamics in two- and three-dimensional Fermi Liquids.** Coffey, D.; Bedell, K.S. Los Alamos National Lab., NM (United States). [1993]. 5p. Sponsored

by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930367–4: Conference on spectroscopies in novel superconductors, Santa Fe, NM (United States), 17-19 Mar 1993). Order Number DE93012673. Source: OSTI; NTIS; INIS; GPO Dep.

We compare the self-energy and entropy of a two- and three-dimensional Fermi Liquids (FLs) using a model with a contact interaction between fermions. For a two-dimensional (2D) FL we find that there are T^2 contributions to the entropy from interactions separate from those due to the collective modes. These T^2 contributions arise from nonanalytic corrections to the real part of the self-energy and areanalogous to $T^3 \ln T$ contributions present in the entropy of a three-dimensional (3D) FL. The difference between the 2D and 3D results arises solely from the different phase space factors.

6655 Direct Energy Conversion

25231 (SAND–93-2805C) **Stagnation dynamics and heating mechanisms for wire array z-pinch implosions.** Spielman, R.B. (Sandia National Labs., Albuquerque, NM (United States)); De Groot, J.S.; Nash, T.J.; McGurn, J.; Ruggles, L.; Vargas, M.; Estabrook, K.G. Sandia National Labs., Albuquerque, NM (United States). [1993]. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-9304126–3: 3. international conference on dense z-pinches, London (United Kingdom), 19-23 Apr 1993). Order Number DE93012843. Source: OSTI; NTIS; GPO Dep.

We have conducted experiments with aluminum, copper, and gold wires arrays to study x-ray production, z-pinch stability, and heating mechanisms. Time-resolved x-ray pinhole camera data and PCD data clearly show that the maximum in the keV x-ray production occurs after peak compression during an expansion phase. The data are consistent with a sheath whose width is determined by the number of wires of the initial array (azimuthal uniformity) and the array diameter. The final stagnated size of the pinch is set by that sheath thickness. The stagnation event is characterized by a relatively uniform initial pinch reaching, in some cases, a diameter < 1 mm, followed by a disruption and increased x-ray production. The source of this energy is apparently not kinetic. The kinetic portion of the energy should have been converted to thermal energy near the time of maximum compression. For aluminum and copper wire arrays, heating from classical Spitzer resistivity is insufficient to explain the observed x-ray yields. While our present data does not show the actual location of current sheath nor does it give the position of non-radiating plasmas and, hence, is incomplete, the data when taken as a whole is strongly suggestive of enhanced resistive dissipation and an MHD instability with a helical shape.

70 PLASMA PHYSICS AND FUSION

Refer also to citation(s) 23147, 24883, 24914

7003 Plasma Physics and Fusion Research

Refer also to citation(s) 24224, 24226, 24282, 24346, 24363, 25108, 25170, 25171, 25176, 25185, 25186, 25188, 25189, 25190, 25191, 25293, 25298, 25317, 25319, 25323, 25330, 25331

25232 (DOE/ER/14213–1) **Radiative properties of strongly magnetized plasmas: Progress report, September 1991–December 1992.** Weisheit, J.C. Rice Univ., Houston, TX (United States). Dept. of Space Physics and Astronomy. Dec 1992. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG05-91ER14213. Order Number DE93014098. Source: OSTI; NTIS; GPO Dep.

The subject of atomic properties in the presence of very strong magnetic fields is experiencing a new wave of interest, especially insofar as non-hydrogenic systems are concerned, and we believe the research summarized here is on the crest of that wave. Only recently there have appeared a major review of Thomas-Fermi theory [Spruch, L. 1991, Rev. Mod. Phys. 63 151]; a new set of fundamental theorems pertaining to the Hamiltonian of a (Thomas-Fermi) atom in a strong field [Lieb E.H., Solovej J.P., Yngvason J., Phys. Rev. Lett. 69, 749 (1992)]; and the first numerical, Hartree-Fock (HF) results for multi-electron atoms in strong B fields, but obtained under the restrictive assumption that the ρ- and z-dependence of individual orbitals is completely separable [Miller M.C., Neuhauser D. Mon. Not. R. astr. Soc., 253, 107 (1991)].

25233 (DOE/ER/40333–136) **Experiments with energetic μd and μt emitted from solid hydrogen.** Marshall, G.M. (TRIUMF, Vancouver, BC (Canada)); Beveridge, J.L.; Bailey, J.M.; Beer, G.A.; Knowles, P.E.; Mason, G.R.; Olin, A.; Brewer, J.H.; Forster, B.M.; Huber, T.M.; Pippitt, B.; Jacot-Guillarmod, R.; Schellenberg, L.; Kammel, P. Wyoming Univ., Laramie, WY (United States). [1992]. 10p. Sponsored by USDOE, Washington, DC (United States); Natural Sciences and Engineering Research Council of Canada, Ottawa, ON (Canada). DOE Contract FG02-87ER40333. (CONF-9206276–5: Muon '92 workshop, Uppsala (Sweden), 28 Jun - 3 jul 1992). Order Number DE93010252. Source: OSTI; NTIS; INIS; GPO Dep.

A set of experiments is reviewed which makes use of the emission of muonic deuterium from the surface of a layer of solid hydrogen. The behavior of muons in a solid target system has been studied via detection of muon decay electrons, muonic x-rays, and fusion products (neutrons and charged particles). The emission of muonic deuterium is understood to result from the Ramsauer-Townsend scattering minimum. The energy distribution of the emitted atoms ranges from tenths of eV to about 10eV, and can be controlled to some extent. A proposal is described to use muonic tritium emission to measure the energy dependence of muonic molecular formation.

25234 (DOE/ER/53198–218) **Reversed-field pinch studies in the Madison Symmetric Torus.** Hokin, S.; Almagri, A.; Cekic, M.; Chapman, B.; Crocker, N.; Den Hartog, D.J.; Fiksel, G.; Henry, J.; Ji, H.; Prager, S.; Sarff, J.; Scime, E.; Shen, W.; Stoneking, M.; Watts, C. Wisconsin Univ., Madison, WI (United States). Plasma Physics Research. 3 Apr 1993. 18p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-85ER53198. Order Number DE93013464. Source: OSTI; NTIS; INIS; GPO Dep.

Studies of large-size ($R = 1.5$ m, $a = 0.5$ m), moderate current ($I < 750$ kA) reversed-field pinch (RFP) plasmas are carried out in the Madison Symmetric Torus in order to evaluate and improve RFP confinement, study general toroidal plasma MHD issues, determine the mechanism of the RFP dynamo, and measure fluctuation-induced transport and anomalous ion heating. MST confinement has been improved by reduction of magnetic field errors with correction coils in the primary circuit and reduction of impurities using boronization; high densities have been achieved with hydrogen pellet injection. MHD tearing modes with poloidal mode number $m = 1$ and toroidal mode numbers $n = 5$–7 are prevalent and nonlinearly couple to produce sudden relaxations akin to tokamak sawteeth. Edge fluctuation-induced transport has been measured with a variety of insertable probes. Ions exhibit anomalous heating, with increases of ion temperature occuring during strong MHD relaxation. The RFP dynamo has been studied with attention to various possible mechanisms, including motion-EMF drive, the Hall effect, and superthermal electrons. Initial profile control experiments have begun using insertable biased probes and plasma guns. The toroidal field capacity of MST will be upgraded during Summer, 1993 to allow low-current tokamak operation as well as improved RFP operation.

25235 (DOE/ER/53212–212) **Magnetohydrodynamic computation of feedback stabilization of resistive-shell instabilities in the reversed field pinch.** Zita, E.J. Wisconsin Univ., Madison, WI (United States). Plasma Physics Research. 1993. 68p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-85ER53212. Order Number DE93013466. Source: OSTI; NTIS; INIS; GPO Dep.

MHD computations demonstrate that feedback can sustain reversal and reduce loop voltage in resistive-shell reversed field pinch (RFP) plasmas. In the absence of a close-fitting conducting shell, feedback with conducting coils $\sim 2R/a$ tearing modes resonant near axis is found to restore plasma parameters to nearly their levels with a close-fitting conducting shell. When original dynamo modes

are stabilized, neighboring tearing modes grow to maintain the RFP dynamo more efficiently. This suggests that experimentally observed limits on RFP pulselengths to the order of the shell time can be overcome by applying feedback to a few helical modes. Feedback with resistive coils yields information on requirements for more physically realistic feedback systems and on the potentiality of improvement of resistive-shell plasma parameters beyond the conducting-shell case. Plasma response to shell rotation is investigated, and issues relevant to mode locking and feedback rotation of individual modes are discussed.

25236 (DOE/ET/53088–599) **Gyrosheath near the tokamak edge.** Hazeltine, R.D. (Texas Univ., Austin, TX (United States). Inst. for Fusion Studies); Xiao, H.; Valanju, P.M. Texas Univ., Austin, TX (United States). Inst. for Fusion Studies; Texas Univ., Austin, TX (United States). Fusion Research Center. Mar 1993. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG05-80ET53088. Order Number DE93012191. Source: OSTI; NTIS; INIS; GPO Dep.

A new model for the structure of the radial electric field profile in the edge during the H-mode is proposed. Charge separation caused by the difference between electron and ion gyromotion, or more importantly in a tokamak, the banana motion (halo effect) can self-consistently produce an electric dipole moment that causes the sheared radial electric field. The calculated results based on the model are consistent with D-III D and TEXTOR experimental results.

25237 (GA-A–21046) **Direct electron heating and current drive with fast waves in DIII-D.** Pinsker, R.I. (General Atomics, San Diego, CA (United States)); Petty, C.C.; Callis, R.W.; Cary, W.P.; Chiu, S.C.; Freeman, R.L.; deGrassie, J.S.; Harvey, R.W.; Luce, T.C.; Mayberry, M.J.; Prater, R.; Porkolab, M.; Bonoli, P.T.; Baity, F.W.; Goulding, R.H.General Atomics, San Diego, CA (United States). Sep 1992. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-89ER51114 ;AC05-84OR21400 ;W-7405-ENG-48. (CONF-9209290–9: 14. international conference on plasma physics and controlled nuclear fusion research, Wurzburg (Germany), 30 Sep - 7 oct 1992; IAEA-CN–56/E-2-4). Order Number DE93013028. Source: OSTI; NTIS; INIS; GPO Dep.

Experiments on the DIII-D tokamak have been performed to evaluate noninductive current drive with direct electron absorption of the fast Alfven wave (FW) in the ion cyclotron range of frequencies. These experiments have employed a 2 MW 60 NM transmitter connected to a four-element toroidally phased array of loop antennas located at the outside midplane of the DIII-D vacuum vessel. Efficient direct electron heating was obtained with (0, π, 0, π) antenna phasing; H-mode confinement was obtained with direct electron absorption of the fast wave as the sole source of auxiliary heating. Current drive experiments were performed with (0,π/2,π,3π/2) antenna phasing at fast wave power levels up to 1.2 MW. Preheating with 60 GHz ECH was used to increase the single-pass absorption of the fast wave with a directive spectrum. When the fast wave is lunched in the direction that aids the inductively driven current (co-current drive), up to 40% of the 0.4 MA plasma current is sustained noninductively. Counter-current drive strongly affects the sawtoothing behavior, and results in highly peaked electron temperature profiles ($T_e(0) \lesssim 6$ keV) but much smaller driven currents.

25238 (GA-A–21128) **An emerging understanding of H-mode discharges in tokamaks.** Groebner, R.J. General Atomics, San Diego, CA (United States). Dec 1992. 59p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-89ER51114. (CONF-921103–10: Meeting of the Division of Plasma Physics of the American Physical Society, Seattle, WA (United States), 16-20 Nov 1992). Order Number DE93012829. Source: OSTI; NTIS; INIS; GPO Dep.

A remarkable degree of consistency of experimental results from tokamaks throughout the world has developed with regard to the phenomenology of the transition from L-mode to H-mode confinement in tokamaks. The transition is initiated in a narrow layer at the plasma periphery where density fluctuations are suppressed and steep gradients of temperature and density form in a region with large first and second radial derivatives in the $v_E^{\rightarrow} = (E \times B)/B^2$ flow velocity. These results are qualitatively consistent with theories which predict suppression of fluctuations by shear or curvature in vE. The required vE flow is generated very rapidly when the magnitude of the heating power or of an externally imposed radial current exceed threshold values and several theoretical models have been developed to explain the observed changes in the vE flow. After the transition occurs, the altered boundary conditions enable the development of improved confinement in the plasma interior on a confinement time scale. The resulting H-mode discharge has typically twice the confinement of L-mode discharges and regimes of further improved confinement have been obtained in some H-mode scenarios.

25239 (GA-A–21254) **Efficiency of fast wave current drive for a weakly relativistic plasma.** Chiu, S.C. (General Atomics, San Diego, CA (United States)); Lin-Liu, Y.R.; Karney, C.F.F. General Atomics, San Diego, CA (United States). Apr 1993. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-89ER51114 ;AC02-76CH03073. (CONF-9304112–4: 10. topical conference on radio frequency power in plasmas, Boston, MA (United States), 1-3 Apr 1993). Order Number DE93012775. Source: OSTI; NTIS; INIS; GPO Dep.

Current drive by fast waves (FWCD) is an important candidate for steady-state operation of tokamaks. Major experiments using this scheme are being carried out on DIII-D. There has been considerable study of the theoretical efficiency of FWCD. In Refs. 4 and 5, the nonrelativistic efficiency of FWCD at arbitrary frequencies was studied. For DIII-D parameters, the results can be considerably different from the Landau and Alfven limits. At the high temperatures of reactors and DIII-D upgrade, relativistic effects become important. In this paper, the relativistic FWCD efficiency for arbitrary frequencies is studied. Assuming that the plasma is weakly relativistic, i.e., T_e/Mc^2 is small, an analytic expression for FWCD is obtained for high resonant energies ($U_{ph}/u_{Te} \gg$). Comparisons with the results from a numerical code ADJ and the nonrelativistic results shall be made and analytical fits in the whole range of velocities shall be presented.

25240 (GA-A–21258) **Statistical approach to LHCD modeling using the wave kinetic equation.** Kupfer, K. (General Atomics, San Diego, CA (United States)); Moreau, D.; Litaudon, X. General Atomics, San Diego, CA (United States). Apr 1993. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-89ER51114. (CONF-9304112–5: 10. topical conference on radio frequency power in plasmas, Boston, MA (United States), 1-3 Apr 1993). Order Number DE93012831. Source: OSTI; NTIS; INIS; GPO Dep.

Recent work has shown that for parameter regimes typical of many present day current drive experiments, the orbits of the launched LH rays are chaotic (in the Hamiltonian sense), so that wave energy diffuses through the stochastic layer and fills the spectral gap. We have analyzed this problem using a statistical approach, by solving the wave kinetic equation for the coarse-grained spectral energy density. An interesting result is that the LH absorption profile is essentially independent of both the total injected power and the level of wave stochastic diffusion.

25241 (INDC(NDS)–202/GA) **7. meeting of the Atomic and Molecular Data Centre Network, Oak Ridge National Laboratory, Oak Ridge, TN, 9-11 November 1987: Summary report.** Smith, J.J. International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Feb 1988. [54p.] (CONF-8711366–: 7. meeting of the Atomic and Molecular Data Centre Network, Oak Ridge, TN (United States), 9-11 Nov 1987). Order Number DE93626599. Source: OSTI; NTIS (US Sales Only); INIS.

This is a brief summary report of the Seventh Atomic and Molecular Data Centre Network Meeting convened by the IAEA at the Oak Ridge National Laboratory, Oak Ridge, Tennessee, 9-11 November 1987. The goal of the Centre is to provide coordination of the international management of atomic and molecular data pertinent to controlled fusion research and technology. The meeting was attended by twelve representatives of centres from six member states. The meeting resulted in five conclusions: (i) the establishment of a single international atomic and molecular collision data base was stressed to be the short-term priority for the data centre network; (ii) the Specialists' Meeting on "Atomic and Molecular Data for Plasma Edge Studies" was reviewed, and the proposal for

the formation of a coordinated research programme on the production and evaluation of atomic and molecular data for plasma edge studies as a means of generating the needed data for fusion research was endorsed; (iii) it was recommended that the recent report entitled "Recommended Data on Atomic Collision Processes Involving Iron Ions" be published as a special supplement to the Nuclear Fusion journal, 1987. This unit was asked to investigate the possibility to provide data covering recombination processes for iron ions which were not included in the recommended data base; (iv) the participants felt that a meeting covering the Atomic and Molecular and fusion data base was timely and important for maximizing the efficient usage of the Atomic and Molecular collision data base. The convening of a Specialists' Meeting on carbon and oxygen ion collision data was also discussed. Finally, (v) it was proposed that the Atomic and Molecular Data Unit should fully address all discrepancies within the recommended data base. Nine status and progress reports are summarized in the Appendices to the present summary report. Refs, 1 fig., tabs.

25242 (INDC(NDS)–202/GA, pp. 15-18) **Controlled-Fusion Atomic Data Center: Progress report.** Barnett, C.F. (Oak Ridge National Lab., TN (United States)); Gregory, D.C.; Gilbody, H.B. International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Feb 1988. (CONF-8711366–: 7. meeting of the Atomic and Molecular Data Centre Network, Oak Ridge, TN (United States), 9-11 Nov 1987). In *7. meeting of the Atomic and Molecular Data Centre Network, Oak Ridge National Laboratory, Oak Ridge, TN, 9-11 November 1987: Summary report.* [54p.] Order Number DE93626599. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. ATOM COLLISIONS/data compilation; ATOM COLLISIONS/plasma impurities; INFORMATION SYSTEMS; IRON IONS; MEETINGS; PLASMA; PROGRESS REPORT; WALL EFFECTS

25243 (INDC(NDS)–202/GA, pp. 25-28) **Progress report of atomic data group, IPP/Nagoya 1986 - 1987.** Tawara, H. International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Feb 1988. (CONF-8711366–: 7. meeting of the Atomic and Molecular Data Centre Network, Oak Ridge, TN (United States), 9-11 Nov 1987). In *7. meeting of the Atomic and Molecular Data Centre Network, Oak Ridge National Laboratory, Oak Ridge, TN, 9-11 November 1987: Suumary report.* [54p.] Order Number DE93626599. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. 9 refs. ION-ATOM COLLISIONS/cross sections; ION-ATOM COLLISIONS/data compilation; IONIZATION/cross sections; IONIZATION/data compilation; ELECTRON CAPTURE; IONIZATION; IRON IONS; MULTICHARGED IONS; PROGRESS REPORT; X RADIATION

25244 (INDC(NDS)–202/GA, pp. 29) **The Atomic and Molecular Data Centre at Queen's University Belfast: Progress report.** Hughes, J. International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Feb 1988. (CONF-8711366–: 7. meeting of the Atomic and Molecular Data Centre Network, Oak Ridge, TN (United States), 9-11 Nov 1987). In *7. meeting of the Atomic and Molecular Data Centre Network, Oak Ridge National Laboratory, Oak Ridge, TN, 9-11 November 1987: Summary report.* [54p.] Order Number DE93626599. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. ELECTRON-ATOM COLLISIONS/data compilation; ELECTRON-ION COLLISIONS/data compilation; ELECTRON-MOLECULE COLLISIONS/data compilation; IONIZATION/data compilation; IONIZATION; PROGRESS REPORT; WALL EFFECTS

25245 (INDC(NDS)–202/GA, pp. 47-49) **Activities in the A and M data at ENEA Bologna, Italy. November, 1987.** International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Feb 1988. (CONF-8711366–: 7. meeting of the Atomic and Molecular Data Centre Network, Oak Ridge, TN (United States), 9-11 Nov 1987). In *7. meeting of the Atomic and Molecular Data Centre Network, Oak Ridge National Laboratory, Oak Ridge, TN, 9-11 November 1987: Summary report.* [54p.] Order Number DE93626599. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. NEUTRAL-PARTICLE TRANSPORT/monte carlo method; NEUTRAL-PARTICLE TRANSPORT/plasma impurities; PLASMA IMPURITIES/electron-atom collisions; CHARGE EXCHANGE; ELECTRON-MOLECULE COLLISIONS; ION-ATOM COLLISIONS; ION-MOLECULE COLLISIONS; IONIZATION; PLASMA; PROGRESS REPORT

25246 (INDC(NDS)–202/GA, pp. 50-53) **Progress report of the A and M Data Unit.** Smith, J.J. (International Atomic Energy Agency, Vienna (Austria). Atomic and Molecular Data Unit). International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Feb 1988. (CONF-8711366–: 7. meeting of the Atomic and Molecular Data Centre Network, Oak Ridge, TN (United States), 9-11 Nov 1987). In *7. meeting of the Atomic and Molecular Data Centre Network, Oak Ridge National Laboratory, Oak Ridge, TN, 9-11 November 1987: Summary report.* [54p.] Order Number DE93626599. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. ELECTRON-ION COLLISIONS/data compilation; ION-ATOM COLLISIONS/data compilation; ION-MOLECULE COLLISIONS/data compilation; IAEA; INFORMATION SYSTEMS; PLASMA CONFINEMENT; PLASMA IMPURITIES; PROGRESS REPORT; WALL EFFECTS

25247 (INDC(NDS)–210/GA) **IAEA specialists' meeting on carbon and oxygen collision data for fusion plasma research: Summary report.** Janev, R.K. International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Sep 1988. [22p.] (CONF-8805213–: IAEA specialists' meeting on carbon and oxygen collision data for fusion plasma research, Vienna (Austria), 9-13 May 1988). Order Number DE93627108. Source: OSTI; NTIS (US Sales Only); INIS.

Summary report of an IAEA Specialists' Meeting on the "Carbon and Oxygen Collision Data for Fusion Plasma Research", convened on 12, 13 May 1988 by the IAEA Atomic and Molecular Data Unit is provided. The review of the data status and requirements for these ions is presented through the Reports of the Working Groups. The conclusions and recommendations of the meeting are also summarized. Refs, figs and tabs.

25248 (INDC(NDS)–210/GA, pp. 7-12) **Report of the working group on the spectroscopic and electron-impact collision data base for C^{q+} and O^{q+} ions.** Phaneuf, R.A.; Defrance, P.; Griffin, D.C.; Hahn, Y.; Pindzola, M.S.; Roszman, L.; Wiese, W. International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Sep 1988. (CONF-8805213–: IAEA specialists' meeting on carbon and oxygen collision data for fusion plasma research, Vienna (Austria), 9-13 May 1988). In *IAEA specialists' meeting on carbon and oxygen collision data for fusion plasma research: Summary report.* [22p.] Order Number DE93627108. Source: OSTI; NTIS (US Sales Only); INIS.

A brief overview is given of the status of the carbon and oxygen atomic data base for electron-impact excitation, ionization and recombination, and for spectroscopic data. Deficiencies for fusion plasma research applications are identified. Additional data are most critically needed for dielectronic and radiative recombination. (author). 10 refs, 1 fig., 3 tabs.

25249 (INDC(NDS)–210/GA, pp. 13-16) **Report of the working group on the data base for collisions of C^{q+} and O^{q+} ions with H, H_2 and He.** Gilbody, J.B. (and others); Salin, A.; Aumayr, R. International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Sep 1988. (CONF-8805213–: IAEA specialists' meeting on carbon and oxygen collision data for fusion plasma research, Vienna (Austria), 9-13 May 1988). In *IAEA specialists' meeting on carbon and oxygen collision data for fusion plasma research: Summary report.* [22p.] Order Number DE93627108. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. ELECTRON CAPTURE/cross sections; ION-ATOM COLLISIONS/data compilation; ION-MOLECULE COLLISIONS/data compilation; IONIZATION/cross sections; CARBON IONS; EV RANGE; EXCITED STATES; HELIUM; HELIUM IONS; HYDROGEN; HYDROGEN IONS; IONIZATION; KEV RANGE;

MEV RANGE 01-10; OXYGEN IONS; PLASMA IMPURITIES; PROGRESS REPORT

25250 (INDC(NDS)–211/GA) **IAEA consultants' meeting on atomic data base and fusion applications interface, Vienna, 9-13 May 1988: Summary report.** Janev, R.K. International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Sep 1988. [63p.] (CONF-8805213–: IAEA specialists' meeting on carbon and oxygen collision data for fusion plasma research, Vienna (Austria), 9-13 May 1988). Order Number DE93627109. Source: OSTI; NTIS (US Sales Only); INIS.

The Summary Report of the IAEA Consultants' Meeting on the "Atomic Data Base and Fusion Applications Interface" held at the IAEA Headquarters in Vienna on May 9-13, 1988, is provided. The Report contains a brief review of the meeting proceedings, and the reports of the Working Groups on the A and M dictionary (labelling/indexing system) and on the data storage and exchange system. The conclusions and recommendations of the meeting are also summarized. (author). Figs and tabs.

25251 (INDC(NDS)–225/MS) **IAEA specialists' meeting on required atomic database for neutral beam penetration in large tokamaks: Summary report.** Janev, R.K. International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Jul 1989. [43p.] (CONF-8904446–: IAEA specialists' meeting on required atomic database for neutral beam penetration in large tokamaks, Vienna (Austria), 10-12 Apr 1989). Order Number DE93627110. Source: OSTI; NTIS (US Sales Only); INIS.

This Summary Report contains the proceedings, conclusions and recommendations of the Specialists' Meeting on the "Required Atomic Database for Neutral Beam Penetration in Large Tokamaks" convened on 10-12 April 1989, at the IAEA Headquarters in Vienna, Austria, by the IAEA Atomic and Molecular Data Unit. The existing database for collisions of energetic hydrogen atoms with electron, protons and plasma impurity ions, as well as the new results presented at the Meeting were critically analyzed, the accuracies of the data were assessed, and recommendations were given regarding the best set of available cross section data to be used in neutral beam penetration codes.

25252 (INDC(NDS)–225/MS, pp. 5-9) **Working group report on the required atomic database for neutral hydrogen beam penetration in large tokamaks.** Cox, M.; Boley, C.D.; Janev, R.K. International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Jul 1989. (CONF-8904446–: IAEA specialists' meeting on required atomic database for neutral beam penetration in large tokamaks, Vienna (Austria), 10-12 Apr 1989). In *IAEA specialists' meeting on required atomic database for neutral beam penetration in large tokamaks: Summary report.* [43p.] Order Number DE93627110. Source: OSTI; NTIS (US Sales Only); INIS.

This report discusses the required atomic database for the physical processes involved in the beam attenuation kinetics, when multistep processes are included, i.e., electron and proton impact processes, impurity-ion impact processes, radiative processes, as well as Lorentz field ionization. It also discusses the required accuracies of different parts of the data base in order to achieve the overall accuracy of about 10 percent that is required for the total beam stopping power cross section. 3 refs.

25253 (INDC(NDS)–225/MS, pp. 10-17) **Working group report on electron-impact processes: Recommended database for electron impact excitation and ionization.** Heer, F.J. de; Janev, R.K.; Smith, J.J. International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Jul 1989. (CONF-8904446–: IAEA specialists' meeting on required atomic database for neutral beam penetration in large tokamaks, Vienna (Austria), 10-12 Apr 1989). In *IAEA specialists' meeting on required atomic database for neutral beam penetration in large tokamaks: Summary report.* [43p.] Order Number DE93627110. Source: OSTI; NTIS (US Sales Only); INIS.

The cross section database for electron impact excitation and electron impact ionization for hydrogen beam kinetic energies greater than 100 eV was considered, giving for each particular process a reference to a recommended publication of cross sections, as well as the accuracy or estimated accuracy. The work is motivated by the application of neutral beam injection in magnetic confinement devices, such as large tokamaks. 9 refs, 2 figs.

25254 (INDC(NDS)–225/MS, pp. 19-27) **Working group report on ion-impact excitation: Recommended database for ion-impact excitation of atomic hydrogen.** Fritsch, W.; Olson, R.E.; Schartner, K.H.; Belkic, D.S. International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Jul 1989. (CONF-8904446–: IAEA specialists' meeting on required atomic database for neutral beam penetration in large tokamaks, Vienna (Austria), 10-12 Apr 1989). In *IAEA specialists' meeting on required atomic database for neutral beam penetration in large tokamaks: Summary report.* [43p.] Order Number DE93627110. Source: OSTI; NTIS (US Sales Only); INIS.

This report discusses (i) proton impact excitation, and (ii) excitation by ion collisions (from helium ions to iron ions) of atomic hydrogen, both for H(1s) and H(n>1), where where n = the principal quantum number, in the energy range from 1 keV/amu to 2 MeV/amu and 10 MeV/amu, respectively. For the range of ions considered, a few generic plots are given for the total cross section as a function of E/q, where E is the beam energy, for different values q (ion charge in units of proton charge) and different final principal quantum numbers. 12 refs, 3 figs.

25255 (INDC(NDS)–225/MS, pp. 29-33) **Working group report on electron removal: Recommended database for charge exchange and ionization.** Gilbody, H.B.; Crothers, D.S.F.; Szucs, S. International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Jul 1989. (CONF-8904446–: IAEA specialists' meeting on required atomic database for neutral beam penetration in large tokamaks, Vienna (Austria), 10-12 Apr 1989). In *IAEA specialists' meeting on required atomic database for neutral beam penetration in large tokamaks: Summary report.* [43p.] Order Number DE93627110. Source: OSTI; NTIS (US Sales Only); INIS.

The available data on (i) collisions of protons with hydrogen atoms (both charge exchange and ionization) and (ii) collisions of fully stripped plasma impurity ions with hydrogen atoms are discussed with regard to recommendations for a database applicable to neutral atom beam injection in magnetic confinement devices. 11 refs, 1 fig.

25256 (INDC(NDS)–236/M5) **IAEA advisory group meeting on atomic and molecular data for metallic impurities in fusion plasmas: Summary report.** Janev, R.K. International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Jul 1990. [25p.] (CONF-9005397–: IAEA Advisory Group meeting on atomic and molecular (A and M) data for metallic impurities in fusion plasmas: Collision processes of metallic ions in fusion plasmas, Vienna (Austria), 16-18 May 1990;. Order Number DE93624938. Source: OSTI; NTIS (US Sales Only); INIS.

The present Report contains the Summary of the IAEA Advisory Group Meeting on "Atomic and Molecular Data for Metallic Impurities in Fusion Plasmas" which was organized by the IAEA Atomic and Molecular Data Unit and held on May 16-18, 1990 in Vienna, Austria. The Meeting Proceedings are briefly described and the Working Group Reports on electron impact and heavy particle collisions are reproduced. The meeting conclusions regarding the data status and the recommendations for future IAEA activities in this data area are also included. (author). Refs and tabs.

25257 (INDC(NDS)–253/N2) **IAEA consultants' meeting on He-beam data base for alpha particle diagnostics of fusion plasmas: Summary report.** Janev, R.K. International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Jan 1992. [55p.] (CONF-9106429–: IAEA consultants' meeting on He-beam data base for alpha particle diagnostics fo fusion plasmas, Vienna (Austria), 3-5 Jun 1991). Order Number DE93626995. Source: OSTI; NTIS (US Sales Only); INIS.

The present Report contains the Summary of the IAEA Consultants' Meeting on "He-Beam Data Base for Alpha Particle Diagnostics of Fusion Plasmas" which was organized by the Atomic and Molecular Data Unit and held on June 3-5, 1991 at the IAEA Headquarters in Vienna, Austria. The Meeting Proceedings are briefly described and the reports of the Working Groups on the

electron- and ion-impact processes are reproduced. A survey on the atomic data needs and required cross section accuracies for helium beam stopping calculations and alpha particle diagnostics of JET- and ITER-like plasmas is included. The conclusions and recommendations of the Meeting regarding the status of present data base (availability and quality) and the needs for its improvement are also given in this Summary Report. (author). Refs, figs and tabs.

25258 (INDC(NDS)–253/N2, pp. 13-19) **Survey of atomic data base needs and accuracies for helium beam stopping and alpha particle diagnostics for ITER.** Summers, H.P.; Hellermann, M. von. International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Jan 1992. (CONF-9106429–: IAEA consultants' meeting on He-beam data base for alpha particle diagnostics fo fusion plasmas, Vienna (Austria), 3-5 Jun 1991). In *IAEA consultants' meeting on He-beam data base for alpha particle diagnostics of fusion plasmas: Summary report.* [55p.] Order Number DE93626995. Source: OSTI; NTIS (US Sales Only); INIS.

This report is concerned with establishing a recommended collection of atomic collision data for the modelling, experimental investigation and exploitation of helium beams. The motivation stems from proposals for diagnostic beams for the ITER tokamak, targeted at alpha particle measurement via double charge transfer, neutralized alpha particle analysis and spectroscopic analysis of recombination radiation. The report discusses the beam energies, species involved in collisions with the helium atom beam (fuel, helium ash and plasma impurities) and plasma conditions prevailing in large tokamak devices. It also lists the required cross-section data.

25259 (INDC(NDS)–254) **IAEA consultants' meeting on atomic data base for Be and B: Summary report.** Janev, R.K. International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Sep 1991. [36p.] (CONF-9106430–: IAEA consultants' meeting on atomic data base for Be and B, Vienna (Austria), 10-12 Jun 1991). Order Number DE93626996. Source: OSTI; NTIS (US Sales Only); INIS.

This Summary Report contains the proceedings, conclusions and recommendations of the IAEA Consultants' Meeting on the "Atomic Data Base for Be and B" organized by the Agency's Atomic and Molecular Data Unit, and convened on June 10-12, 1991, at the IAEA Headquarters in Vienna, Austria. The existing collisional data base for these plasma impurities was thoroughly analyzed and critically evaluated at the Meeting. Many new, original results for both electron-impact and heavy-particle collisions of Be and B ions were reported at the Meeting, contributing significantly to the completion of the data base. The data analysis (including assessment of accuracies) and the recommendations of the Meeting regarding the best available collisional data for these impurities are given in two working Group Reports reproduced in this Summary Report. Analytic fits to the recommended electron-impact ionization cross section, prepared by Dr. D.L. Moores after the meeting, are also included in the present Report. (author). Refs, figs and tabs.

25260 (INDC(NDS)–254, pp. 31-36) **Analytic fits of the recommended electron impact ionization cross sections for Be and B ions and atoms.** Moores, D.L. (University Coll., London (United Kingdom). Dept. of Physics and Astronomy). International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Sep 1991. (CONF-9106430–: IAEA consultants' meeting on atomic data base for Be and B, Vienna (Austria), 10-12 Jun 1991). In *IAEA consultants' meeting on atomic data base for Be and B: Summary report.* [36p.] Order Number DE93626996. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. ELECTRON-ATOM COLLISIONS/cross sections; ELECTRON-ION COLLISIONS/beryllium ions; ELECTRON-ION COLLISIONS/boron ions; ELECTRON-ION COLLISIONS/cross sections; ANALYTIC FUNCTIONS; EVALUATED DATA; IONIZATION; METASTABLE STATES

25261 (INDC(NDS)–255) **Radiative losses and electron cooling rates for carbon and oxygen plasma impurities.** Marchand, R. (Institut National de la Recherche Scientifique (INRS), Varennes (Canada)); Bonnin, X. International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Jan 1992. [64p.] Order Number DE93627111. Source: OSTI; NTIS (US Sales Only); INIS.

Radiative losses and electron cooling rates are calculated for carbon and oxygen ions under conditions relevant to fusion plasmas. Both rates are calculated with the most recent recommended atomic data. A modified coronal model which includes the effects of metastable states is described and used to calculate the rates. Comparisons with other approaches are also discussed. (author). 36 ref, figs.

25262 (INDC(NDS)–257/N8) **IAEA advisory group meeting on atomic and molecular data for fusion plasma impurities: Summary report.** Janev, R.K. International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Feb 1992. [42p.] (CONF-9109485–: IAEA advisory group meeting on atomic and molecular data for fusion plasma impurities, Vienna (Austria), 25-27 Sep 1991). Order Number DE93627112. Source: OSTI; NTIS (US Sales Only); INIS.

This Summary Report briefly summarizes the proceedings, conclusions and recommendations of the IAEA Advisory Group Meeting on "Atomic and Molecular Data for Fusion Plasma Impurities", held at the IAEA Headquarters in Vienna on 25-27 September 1991. The reports of the two Meeting Working Groups regarding the data status and needs for spectroscopic and collisional data on plasma impurities are also included. Refs, figs and tabs.

25263 (INDC(NDS)–257/N8, pp. 11-19) **Spectroscopic and electron-ion collision data for plasma impurities.** Faenov, A.; Marchand, R.; Tawara, H.; Vainshtein, L.; Wiese, W. International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Feb 1992. (CONF-9109485–: IAEA advisory group meeting on atomic and molecular data for fusion plasma impurities, Vienna (Austria), 25-27 Sep 1991). In *IAEA advisory group meeting on atomic and molecular data for fusion plasma impurities: Summary report.* [42p.] Order Number DE93627112. Source: OSTI; NTIS (US Sales Only); INIS.

This Working Group Report briefly reviews and summarizes the available spectroscopic and electron-ion collision data for plasma impurities. Included are lithium, neon, and argon, which, although they are not plasma impurities per se, are introduced into the plasma through the application of diagnostic techniques. 32 refs, 2 tabs.

25264 (INDC(NDS)–257/N8, pp. 20-24) **Working group report on atomic data status and needs concerning plasma impurities colliding with H, H_2 and He.** Schultz, D.R. (and others); Katsonis, K.; Janev, R.K. International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Feb 1992. (CONF-9109485–: IAEA advisory group meeting on atomic and molecular data for fusion plasma impurities, Vienna (Austria), 25-27 Sep 1991). In *IAEA advisory group meeting on atomic and molecular data for fusion plasma impurities: Summary report.* [42p.] Order Number DE93627112. Source: OSTI; NTIS (US Sales Only); INIS.

This Working Group Report briefly summarizes the status and needs regarding collisions between atomic and molecular hydrogen and helium with plasma impurities, especially the metallic ions. The conclusions of the present Working Group are also presented. 10 refs.

25265 (INDC(NDS)–257/N8, pp. 33-39) **Data needs for electron transfer processes of MeV heavy (positive and negative) ions, applied to electro-magnetic field measurements in plasmas.** Tawara, H. (National Inst. for Fusion Science, Nagoya (Japan)). International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Feb 1992. (CONF-9109485–: IAEA advisory group meeting on atomic and molecular data for fusion plasma impurities, Vienna (Austria), 25-27 Sep 1991). In *IAEA advisory group meeting on atomic and molecular data for fusion plasma impurities: Summary report.* [42p.] Order Number DE93627112. Source: OSTI; NTIS (US Sales Only); INIS.

The status of and the need for atomic data pertinent to both positive and negative ion collisions with neutrals and of positive, singly charged ion collisions with plasma ions is briefly discussed. The relevance for plasma diagnostics, in particular the heavy-ion beam probe method of measuring electromagnetic fields, is pointed out. Urgent needs for particular data are identified. 12 refs, 3 figs.

25266 (INDC(NDS)–257/N8, pp. 41-42) **A and M data needs for the neutral beam heating system for next-step fusion devices.** Belyaev, V.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (Russian Federation). Inst. Atomnoj Ehnergii). International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Feb 1992. (CONF-9109485–: IAEA advisory group meeting on atomic and molecular data for fusion plasma impurities, Vienna (Austria), 25-27 Sep 1991). In *IAEA advisory group meeting on atomic and molecular data for fusion plasma impurities: Summary report.* [42p.] Order Number DE93627112. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. ELECTRON COLLISIONS/data compilation; ION-ATOM COLLISIONS/data compilation; ION-ATOM COLLISIONS/deuterium ions; ION-MOLECULE COLLISIONS/data compilation; ION-MOLECULE COLLISIONS/deuterium ions; ANIONS; EXCITED STATES; ION SOURCES; ITER TOKAMAK; NEUTRAL ATOM BEAM INJECTION

25267 (INIS-mf–13512) **The magnetic field structure of Rotamak discharges.** Durance, G. Flinders Univ. of South Australia, Bedford Park, SA (Australia). Oct 1983. [212p.] Order Number DE93623062. Source: OSTI; NTIS (US Sales Only); INIS.

This thesis describes an experimental study of a field-reversed compact torus configuration which is generated and sustained by a rotating magnetic field. Earlier studies of this so-called 'rotamak' concept used rotating magnetic fields of limited duration ($\approx$15 μs). The rotating magnetic field is produced by feeding RF currents, dephased by 90 deg., through two orthogonal Helmholtz coils which are wound around the outside of a spherical Pyrex vacuum vessel. Line generators are used to supply the RF current pulses. Experiments are performed using an argon plasma. From measurements of the driven toroidal current, two rotamak operating modes are identified. Detailed poloidal flux contour measurements prove that these modes are associated with either a closed magnetic field line, compact torus configuration or an open magnetic field line, mirror-like structure. In the compact torus configuration the driven toroidal current is shown to vary linearly with the magnitude of the externally applied equilibrium field. For the same initial conditions of filling pressure and externally applied equilibrium field, the plasma discharges are highly reproducible. The magnetic structures of the discharges are studied in detail for three such sets of initial conditions. In particular, poloidal flux contours are derived for each of the three conditions. Although no toroidal magnetic field is externally imposed in these experiments, under certain conditions a toroidal field is observed to be present. The toroidal field is in opposite directions in the upper and lower halves of the minor cross section. Measurements of the input power into the plasma show that this power is largely determined by the characteristics of the line-generators. The variation of this input power with time can explain all the features observed in the plasma discharges. The effects of a conducting 'shell' around the vacuum vessel are also investigated. 97 refs., 72 figs., ills.

25268 (INIS-RU–343, pp. 71-73) **Acceleration of power pulse ion beams in plasma-filled magnetic channels.** Kiyashko, V.A. (AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst.); Kornilov, E.A.; Gorban', A.M. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (Russian Federation). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i; AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1991. [80p.] (In Russian). In *Nuclear-physical researches (Theory and experiment): Scientific-technical collection.* Order Number DE93626131. Source: OSTI; NTIS (US Sales Only); INIS.

When high-current ion beams are accelerated in plasma-filled gaps with magnetic channels, it is important to study the efficiency of electron magnetic isolation in such systems. Electron-ion current ratio in an axially symmetric accelerating gap is considered quantitatively for this purpose. Proceeding from the analysis of charged particle motion under accelerating voltages equal to or exceeding several hundred kilovolts, it is shown that ion beam current and full current of the accelerating gap with a magnetic channel can be intercomparable. This feature is in agreement with the results of numerical simulation and experimental data. 10 refs.; 2 figs.

25269 (IPF–91-3) **Diagnostics and modelling of ECRH microwave discharges.** Behringer, K. Stuttgart Univ. (Germany). Inst. fuer Plasmaforschung. Mar 1991. 29p. Order Number DE93795225. Source: OSTI; NTIS (US Sales Only); INIS.

Stationary plasmas in various gases were generated at pressures of some 10 Pa in weak magnetic fields by microwave heating. Quantitative spectroscopy of atomic lines and molecular bands was applied for diagnostic of plasmas in hydrogen, nitrogen, methane and argon-helium mixtures. Simple model calculations were based on the well-known balance equations of glow discharges including chemical reactions especially for methane. Some tests were also performed in nitrogen glow discharges. Excitation, ionisation and dissociation rate coefficients for diagnostic or modelling purposes were taken from nuclear fusion research of calculated from experimental cross sections assuming a Maxwellian energy distribution. The electron temperatures of the discharges, predicted from electron confinement times and ionisation rate coefficients ($\simeq$ 1-4 eV), were well confirmed by the experiment. Due to additional energy losses into vibrational excitation and dissociation, there is a substantial difference in plasma size between atomic and molecular plasmas at given input power. The electron density in molecular plasmas was of the order of the cut-off density, i.e. $\simeq 10^{11}$ cm^{-3}, almost independent of the pressure. The kinetic temperature of the heavy particles was determined form N_2 band rotational intensity distribution ($\simeq$ 500 K), while the rotational temperature of CH bands and the hydrogen gas temperature are higher - a proof of energy gain during CH_4 dissociation. Hydrogen and CH densities were measured in methane plasmas by adding a small amount of argon and comparing H_α and CH molecular bands to Ar line intensities. H and CH particle densities were also derived from model calculations using electron dissociation rate coefficients and respective confinement times for the dissociation products. Some neutral-neutral reactions were also included. (orig./KP).

25270 (IPPCZ–323) **Static characteristics of a conduction and radiation dominated electric arc in nitrogen.** Jenista, J. Ceskoslovenska Akademie Ved, Prague (Czech Republic). Ustav Fyziky Plazmatu. Jul 1992. [37p.] Order Number DE93627106. Source: OSTI; NTIS (US Sales Only); INIS.

The time-dependent energy and circuit equations are solved numerically to obtain temperature profiles, current-voltage characteristics and electric field strength vs. axis temperature diagrams in the asymptotic region of a wall-stabilized electric arc operated in nitrogen. The numerical calculations demonstrate the splitting of the rising branch of the stationary solutions in the current-voltage characteristic. This phenomenon was earlier found experimentally for air. The computations were made for various channel radii and for various series resistances. The steady-state characteristics and convergence to the single branch of solutions is explained on the basis of the linearized Lyapunov stability theory (LIST). Comparison with available results of other authors shows that the analytical solution based on simple polynomial approximation to thermodynamic and transport functions differs significantly from numerical computations. (author) 20 figs., 21 refs.

25271 (JAERI-M–92-178) **Tokamak plasma power balance calculation code (TPC code) outline and operation manual.** Fujieda, Hirobumi (Atomic Data Service, Tokai, Ibaraki (Japan)); Murakami, Yoshiki; Sugihara, Masayoshi. Japan Atomic Energy Research Inst., Tokyo (Japan). Nov 1992. 139p. (In Japanese). Order Number DE93797464. Source: OSTI; NTIS; INIS.

This report is a detailed description on the TPC code, that calculates the power balance of a tokamak plasma according to the ITER guidelines. The TPC code works on a personal computer (Macintosh or J-3100/IBM-PC). Using input data such as the plasma shape, toroidal magnetic field, plasma current, electron temperature, electron density, impurities and heating power, TPC code can determine the operation point of the fusion reactor (Ion temperature is assumed to be equal to the electron temperature). Supplied flux (Volt · sec) and burn time are also estimated by coil design parameters. Calculated energy confinement time is compared with various L-mode scaling laws and the confinement enhancement factor (H-factor) is evaluated. Divertor heat load is predicted by using simple scaling models (constant-χ, Bohm-type-χ and JT-60U empirical scaling models). Frequently used data can

be stored in a 'device file' and used as the default values. TPC code can generate 2-D mesh data and the POPCON plot is drawn by a contour line plotting program (CONPLT). The operation manual about CONPLT code is also described. (author).

25272 (JAERI-M–93-004) **'AEOLUS-IT' MHD simulation code based on a toroidally incompressible plasma model.** Kurita, Gen-ichi (Japan Atomic Energy Research Inst., Naka, Ibaraki (Japan). Naka Fusion Research Establishment); Azumi, Masafumi; Takeda, Tatsuoki. Japan Atomic Energy Research Inst., Tokyo (Japan). Feb 1993. 57p. (In Japanese). Order Number DE93788461. Source: OSTI; NTIS; INIS.

Three dimensional toroidal MHD code 'AEOLUS-IT' has been developed, on a basis of the new reduced set of resistive MHD equations with the assumption of toroidal incompressibility instead of the tokamak ordering in the conventional reduced set of resistive MHD equations. The code can carry out an overall MHD calculation with the effect of finite plasma resistivity, linear and nonlinear, of low aspect ratio and low-q tokamak because the basic equations include the ideal m = 1 mode. The implicit time integration scheme for the linear term of the perturbation is employed, dividing the variables into the equilibrium and perturbation parts. The huge CPU time due to solution of the large matrix can be reduced by high efficiency of vectorialization. The linear calculations, an eigenvalue problem, show the linear growth rates of ideal m = 1 mode and show the comparison of the growth rates between cylindrical and toroidal configurations of low-q tokamak. The linear calculations and nonlinear simulations of resistive ballooning modes are carried out and the both results are in good agreement with those obtained by the toroidal MHD code 'AEOLUS-RT' using the conventional reduced MHD equations. The linear and nonlinear calculations of tearing mode for the numerical equilibrium are also carried out and the almost the same results are obtained as the one obtained using the analytical equilibrium of almost the same parameters. (author).

25273 (LA-UR–93-1382) **MHD simulation of deuterium-fiber-initiated Z-pinches with two-fluid effects.** Sheehey, P. (California Univ., Los Angeles, CA (United States). Dept. of Physics); Lindemuth, I.R. Los Alamos National Lab., NM (United States). [1993]. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9304126–1: 3. international conference on dense z-pinches, London (United Kingdom), 19-23 Apr 1993). Order Number DE93012682. Source: OSTI; NTIS; GPO Dep.

Two-dimensional "cold-start" resistive MHD computations of formation and evolution of deuterium-fiber-initiated Z-pinches have been extended to include separate ion and electron energy equations and finite-Larmor-radius ordered terms. In the Ohm's Law (magnetic field evolution) equation, Hall and diamagnetic pressure terms have been added, and corresponding terms have been added to the energy equations. Comparison is made of the results of these computations with previous computations and with experiments.

25274 (LA-UR–93-1393) **Two-dimensional simulations of foil implosion experiments on the Los Alamos capacitor bank.** Peterson, D.L.; Bowers, R.L.; Brownell, J.H.; Greene, A.E.; Lee, H.; Matuska, W. Los Alamos National Lab., NM (United States). [1993]. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9304126–7: 3. international conference on dense z-pinches, London (United Kingdom), 19-23 Apr 1993). Order Number DE93012676. Source: OSTI; NTIS; GPO Dep.

A number of z-pinch experiments have been conducted at Los Alamos on the Pegasus capacitor bank in which 2-cm high, 5-cm radius, thin foil loads were imploded with currents in excess of 3 MA. Two-dimensional radiation magnetohydrodynamic (RMHD) simulations of these implosions have been performed to model the implosion dynamics and subsequent generation of an x-ray pulse. Comparison of the simulation instability development with visible light framing camera photographs show good agreement and illustrate the instability evolution from short to long wavelengths and a final disruption of the imploding plasma shell. The calculations also show good agreement with experimental timing and measured current and voltage waveforms, and also reproduce features characteristic of the x-ray output. These include a broad pulsewidth, and thepresence of multiple peaks and small time scale structures, features which cannot be reproduced by one-dimensional models. X-ray spectra obtained from the calculated pinch also reproduce qualitative features inthe measured spectra.

25275 (LRP–471/93) **On absorption of low frequency electromagnetic fields.** Brunner, S. (Ecole Polytechnique Federale, Lausanne (Switzerland). Centre de Recherche en Physique des Plasma (CRPP)); Vaclavik, J. Ecole Polytechnique Federale, Lausanne (Switzerland). Centre de Recherche en Physique des Plasma (CRPP). Mar 1993. [13p.] Order Number DE93627089. Source: OSTI; NTIS; INIS.

The drift kinetic equation (DKE) is used to establish a formula for power absorption of small amplitude, low frequency electromagnetic (EM) fields in a hot toroidal axisymmetric plasma. The stationary plasma is first considered. Electrons and ions are described by local Maxwellian distributions, alpha particles by a local slowing-down distribution. The fluctuating part of the distribution function for each species is then evaluated from the linearized DKE in terms of the EM fields using a perturbation method. The parameter $b_p=B_p/B_o$, where B_p is the poloidal component of the magnetostatic field B_o, and the parameter $v_d/\lambda\omega$, where v_d is the magnetic curvature drift, λ the wavelength perpendicular to B_o and ω the frequency of the EM fields, are considered to be small. By integrating the resulting distribution function over velocity space, an explicit formula for the power absorbed by each species is obtained. To obtain an expression suitable for direct implementation in an ideal-MHD code, the electric field component parallel to the magnetostatic field is evaluated using the quasi-neutrality equation. (author) 4 refs.

25276 (ORNL/TM–12209) **Transport mechanisms acting in toroidal devices: A theoretician's view.** Carreras, B.A. Oak Ridge National Lab., TN (United States). Jan 1993. 26p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93013463. Source: OSTI; NTIS; INIS; GPO Dep.

Understanding the basic mechanisms of transport in toroidal confinement devices remains one of the more challenging scientific issues in magnetic confinement. At the same time, it is a critical issue for the magnetic fusion program. Recent progress in understanding fluctuations and transport has been fostered by the development and use of new diagnostics, bringing new perspectives on these studies. This has stimulated new theoretical developments. A view of the most recent issues and progress in this area is given. The role of long wavelengths in core transport and the relation between shear flows and turbulence at the plasma edge are the primary topics considered.

25277 (PPPL–2882) **The high density and high B_{pol} disruption mechanism on TFTR.** Fredrickson, E.D. (Princeton Univ., NJ (United States). Plasma Physics Lab.); Manickam, J.; McGuire, K.M.; Monticello, D.; Nagayama, Y.; Park, W.; Taylor, G.; Drake, J.F.; Kleva, R.G. Princeton Univ., NJ (United States). Plasma Physics Lab. Apr 1993. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03073. (CONF-9206247–6: 19. European Physical Society (EPS) conference on controlled fusion and plasma physics, Innsbruck (Austria), 29 Jun - 4 jul 1992). Order Number DE93011982. Source: OSTI; NTIS; INIS; GPO Dep.

Short communication. TFTR TOKAMAK/plasma disruption; ELECTRON TEMPERATURE; TEMPERATURE DISTRIBUTION; ECR HEATING; PLASMA DENSITY

25278 (PPPL–2890) **ICRF heating on TFTR-effect on stability and performance.** Wilson, J.R.; Bell, M.G.; Biglari, H.; Bitter, M.; Bretz, N.L.; Budny, R.; Chen, L.; Darrow, D.; Efthimion, P.C.; Fredrickson, E.; Fu, G.Y.; Grek, B.; Grisham, L.R.; Hammett, G.; Hawryluk, R.J.; Hosea, J.C.; Janos, A.; Jassby, D.; Jobes, F.C.; Johnson, D.WPrinceton Univ., NJ (United States). Plasma Physics Lab. Mar 1993. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03073. (IAEA-CN–56/E-2-2;CONF-920913–28: 14. international conference on plasma physics and controlled nuclear fusion research, Wuerzburg (Germany), 30 Sep - 7 oct 1992). Order Number DE93011496. Source: OSTI; NTIS; INIS; GPO Dep.

With the addition of two new antennas and two radiofrequency (RF) generators, the TFTR ICRF system is complete. The total complement of four antennas and six generators is designed for 12.5 MW operation. Experiments with this system have been performed recently on TFTR in the low recycling regime to increase the performance of supershot plasmas, in a non-resonant regime to explore electron heating, and in high recycling discharges with energetic ion tails to simulate fusion alpha particles. Noteworthy results include: direct electron heating observed with absorption rates in agreement with theory; electron heating of supershot plasmas (ΔTEO $\sim$ 2 key) via energetic ion tails that would increase the pressure of the alpha particles in DT plasmas; and the first observation of the toroidal Alfven eigenmode (TAE) instability driven by the energetic ion tail in hydrogen minority heating.

25279 (PPPL–2891) **Charged fusion product and fast ion loss in TFTR.** Zweben, S.J. (Princeton Univ., NJ (United States). Plasma Physics Lab.); Darrow, D.S.; Fredrickson, E.D.; Mynick, H.E.; White, R.B.; Biglari, H.; Bretz, N.; Budny, R.; Bush, C.E.; Chang, C.S.; Chen, L.; Cheng, C.Z.; Fu, G.Y.; Hammett, G.W.; Hawryluk, R.J.;Princeton Univ., NJ (United States). Plasma Physics Lab. Mar 1993. 19p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03073. (IAEA-CN–56/A-6-3;CONF-920913–29: 14. international conference on plasma physics and controlled nuclear fusion research, Wuerzburg (Germany), 30 Sep - 7 oct 1992). Order Number DE93011494. Source: OSTI; NTIS; INIS; GPO Dep.

Several different fusion product and fast ion loss processes have been observed in TFTR using an array of pitch angle, energy and time resolved scintillator detectors located near the vessel wall. For D-D fusion products (3 MeV protons and 1 MeV tritons) the observed loss is generally consistent with expected first-orbit loss for Ip < 1.4 MA, except near the outer midplane where stochastic TF ripple loss dominates when Ip > I MA. However, at higher currents, Ip = 1.4–2.5 MA, an NM induced D-D fusion product loss can be up to 3-4 times larger than the first-orbit loss, particularly at high beam powers, P $\geq$ 25 MW. The MHD induced loss of 100 KeV neutron beam ions and ~0.5 MeV ICRF minority tail tons has also been measured $\leq$ 459 below the outer midplane. be potential implications of these results for D-T alpha particle experiments in TFTR and ITER are described.

25280 (PPPL–2893) **X-ray diagnostics of tokamak plasmas.** Bitter, M.; Hsuan, H.; Hill, K.W.; Zarnstorff, M. Princeton Univ., NJ (United States). Plasma Physics Lab. Apr 1993. 33p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03073. (CONF-920963–2: 4. international colloquium on atomic spectra and oscillator strengths for astrophysics and laboratory plasmas, Gaithersburg, MD (United States), 14-17 Sep 1992). Order Number DE93011977. Source: OSTI; NTIS; INIS; GPO Dep.

This paper discusses the influence that salinity has on the bioavailability of the two largest classes of contaminants, trace metals and organic compounds will be discussed. Although data on contaminant toxicity will be used to draw inferences about chemical availability, this discussion will focus on the properties that contaminants are likely to exhibit in waters of varying salinities. In addition, information on physiological changes that are affected by salinity will be used to illustrate how biological effects can alter the apparent availability of contaminants.

25281 (PPPL–2896) **Achieving high fusion reactivity in high poloidal beta discharges in TFTR.** Manuel, M.E. (Columbia Univ., New York, NY (United States). Dept. of Applied Physics); Navratil, G.A.; Sabbagh, S.A.; Batha, S.; Bell, M.G.; Bell, R.; Budny, R.V.; Bush, C.E.; Cavallo, A.; Chance, M.S.; Cheng, C.Z.; Efthimion, P.C.; Fredrickson, E.D.; Fu,.Princeton Univ., NJ (United States). Plasma Physics Lab. Apr 1993. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03073 ;FG02-90ER54084 ;FG02-89ER53297. (IAEA-CN–56/A-III-4;CONF-9210315–4: 14. international conference on plasma physics and controlled nuclear fusion research, Wurzburg (Germany), Oct 1992). Order Number DE93011980. Source: OSTI; NTIS; INIS; GPO Dep.

High poloidal beta discharges have been produced in TFTR that achieved high fusion reactivities at low plasma currents. By rapidly decreasing the plasma current just prior to high-power neutral beam injection, relatively peaked current profiles were created having high $l_i > 2$, high Troyon-normalized beta, $\beta N > 3$, and high poloidal beta. $\beta_p \geq 0.7$ R/a. The global energy confinement time after the current ramp was comparable to supershots, and the combination of improved MHD stability and good confinement produced a new high $\epsilon\beta_p$ high Q_{DD} operating mode for TFTR. Without steady-state current profile control, as the pulse lengths of high βp discharges were extended, l_i decreased, and the improved stability produced immediately after by the current ramp deteriorated. In four second, high $\epsilon\beta_p$ discharges, the current profile broadened under the influence of bootstrap and beam-drive currents. When the calculated voltage throughout the plasma nearly vanished, MHD instabilities were observed with β_N as low as 1.4. Ideal MHD stability calculations showed this lower beta limit to be consistent with theoretical expectations.

25282 (Riso-R–659(EN)) **Electrostatic turbulence in strongly magnetized plasmas.** Nielsen, A.H. Risoe National Lab., Roskilde (Denmark). Optics and Fluid Dynamics Dept.; Danmarks Tekniske Hoejskole, Lyngby (Denmark). Jan 1993. [81p.] Order Number DE93627052. Source: OSTI; NTIS; INIS.

Turbulence in plasmas has been investigated experimentally and numerically. On the experimental side the turbulent nature of the Kelvin-Helmholtz instability has been studied in a single-ended Q-machine. The development of coherent structures in the background of the turbulent flow has been demonstrated and the capability of structures of transporting plasma across the magnetic field-lines is explained in detail. The numerical investigations are divided into two parts: Numerical simulations of the dynamics from the Q-machine experiments using spectral methods to solve the two-dimensional Navier-Stokes equations in a cylindrical geometry. A numerical study of the Eulerian-Lagrangian transformation in a two-dimensional flow. Here the flow is made up by a large number of structures, where each individual structure is convected by the superposed flow field of all the others. (au) (33 ills., 67 refs.).

25283 (UCRL-JC–109369) **Analysis techniques for directly and indirectly driven hydrodynamic experiments on Nova.** Glendinning, S.G.; Remington, B.A.; Haan, S.W.; Munro, D.H.; Weber, S.V. Lawrence Livermore National Lab., CA (United States). 7 Apr 1992. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-920362–44: 9. topical conference on high-temperature plasma diagnostics, Santa Fe, NM (United States), 15-19 Mar 1992). Order Number DE93009244. Source: OSTI; NTIS; GPO Dep.

Over the past five years we have performed an extensive series of experiments on hydrodynamic (Rayleigh-Taylor) instabilities. Typically such experiments involve the time-resolved radiography of an accelerated foil (planar geometry) with the line of sight of the radiograph along the direction of motion. In comparing experimental data to simulations, the simplest approach is to extract the modulation in exposure level of such a radiograph vs time and compare the inferred growth rate (assumed to be exponential) with the growth rate in column density ($\Delta\rho z$) from a simulation. We have found that this gives unsatisfactory results. We will discuss the techniques for experimental analysis and postprocessing of simulations which we use for a more direct comparison of the data with the simulation, including the extraction of Fourier components vs. time from the data, the effect of backlighter spectra, emission from sources other than the backlighter, and the non-linear effects of instrument response.

25284 (UCRL-JC–109804) **Electron temperature measurements of x-ray laser plasmas.** Young, B.K.F.; Osterheld, A.L.; Shepherd, R.L.; Shimkaveg, G.M.; Cerjan, C.J.; Goldstein, W.H.; Rosen, M.D.; Walling, R.S.; Stewart, R.E. Lawrence Livermore National Lab., CA (United States). 6 Aug 1992. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-920523–9: 3. international colloquium on x-ray lasers, Schliersee (Germany), 18-22 May 1992). Order Number DE93011874. Source: OSTI; NTIS; GPO Dep.

We present results of recent experiments at the NOVA laser to measure the electron temperature of neon-like yttrium X-my laser plasmas. Trace amounts of aluminum were introduced into yttrium exploding-foil targets. Time resolved electron temperatures were determined by comparing the measured aluminum K-shell spectra

with detailed quasi-steady state calculations and are compared to 2D LASNEX hydrodynamics simulations.

25285 (UCRL-JC–111840) **3D gyrokinetic particle-in-cell simulation of fusion plasma microturbulence on parallel computers.** Williams, T.J. Lawrence Livermore National Lab., CA (United States). Dec 1992. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-930372–10: 1993 international simulators conference on high performance computing, Arlington, VA (United States), 29 Mar - 1 apr 1993). Order Number DE93012503. Source: OSTI; NTIS; GPO Dep.

One of the grand challenge problems now supported by HPCC is the Numerical Tokamak Project. A goal of this project is the study of low-frequency microinstabilities in tokamak plasmas, which are believed to cause energy loss via turbulent thermal transport across the magnetic field lines. An important tool in this study is gyrokinetic particle-in-cell (PIC) simulation. Gyrokinetic, as opposed to fully-kinetic, methods are particularly well suited to the task because they are optimized to study the frequency and wavelength domain of the microinstabilities. Furthermore, many researchers now employ low-noise δf methods to greatly reduce statistical noise by modelling only the perturbation of the gyrokinetic distribution function from a fixed background, not the entire distribution function. In spite of the increased efficiency of these improved algorithms over conventional PIC algorithms, gyrokinetic PIC simulations of tokamak fully-vectorized codes on vector supercomputers. For this reason, we have worked for several years to redevelop these codes on massively parallel computers. We have developed 3D gyrokinetic PIC simulation codes for SIMD and MIMD parallel processors, using control-parallel, data-parallel, and domain-decomposition message-passing (DDMP) programming paradigms. This poster summarizes our earlier work on codes for the Connection Machine and BBN TC2000, and our development of a generic DDMP code for distributed-memory parallel machines. We discuss the memory-access issues which are of key importance in writing parallel PIC codes, with special emphasis on issues peculiar to gyrokinetic PIC. We outline the domain decompositions in our new DDMP code and discuss the interplay of different domain decompositions suited for the particle-pushing and field-solution components of the PIC algorithm.

25286 (UCRL-JC–111903) **Measuring opacity of shock generated argon plasmas.** Erskine, D.; Rozsnyai, B.; Ross, M. Lawrence Livermore National Lab., CA (United States). Sep 1992. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9208135–5: International conference on the physics of strongly coupled plasmas, Rochester, NY (United States), 17-21 Aug 1992). Order Number DE93013038. Source: OSTI; NTIS; GPO Dep.

Plasmas are generated by passage of a strong planar shock wave through gas. Initial experiments in argon have produced plasmas with 2 eV temperature, 0.004 gm/cm^3 density, and coupling parameter $\Gamma \sim 0.3-0.7$. Plasmas having $\Gamma > 1$ are attainable with greater initial gas pressure. The opacity of the plasma is measured versus wavelength by recording the risetime of emitted light. Initial measurements are in visible light. Preliminary results are compared with calculations using the HOPE code.

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Refer also to citation(s) 23930, 25124, 25135, 25273, 25283

25287 (ANL/EP/CP–78386) **Modeling of erosion and redeposition processes.** Brooks, J.N. Argonne National Lab., IL (United States). [1992]. 25p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-921053–3: International Atomic Energy Agency technical committee meeting on atomic and plasma material interaction data for fusion reactor technology, Cadarache (France), 12-16 Oct 1992). Order Number DE93008649. Source: OSTI; NTIS; INIS; GPO Dep.

The purpose of erosion/redeposition (E/R) modeling is to predict the effects of sputtering on: (1) erosion rates and lifetimes of tokamak divertors, limiters, and th first wall, (2) tritium co-deposition, and (3) plasma contamination. Because of the specialized and complex phenomena associated with surface derived impurities, in particular surface interactions, sheath transport, and multiple charge state effects, it has proven useful to develop models and computer codes specifically for E/R calculations. These are used in conjunction with codes and analysis of th background hydrogen plasma. The E/R codes fall primarily into two categories: (1) trace impurity content codes for treatment of near-surface and scrape-off layer (SOL) transport, and (2) non-trace codes, e.g., for self-consistent, oblique magnetic field sheath calculations within-sheath ionization of sputtered impurities. The intent of this paper is to review current research activities in E/R modeling with emphasis on the codes mentioned above. Recent applications are describe including analysis for the ITER divertor. Results of several recent code verification activities via comparison with experimental data are discussed. Data needs an sensitivity to ionization rate uncertainties are also discussed. A brief description of work in the key area of surface roughness modeling is included.

25288 (CEA-CONF–11238) **Thermal behaviour of the water-cooled lithium-lead box-shaped Demo blanket during a loss-of-coolant accident.** Giancarli, L.; Proust, E.; Mouquet, N.; Salavy, J.F.; Hernot, M.; Franenberg, H.W. CEA Centre d'Etudes de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Mecanique et de Technologie. 1992. [5p.] (CONF-920930–: 17. symposium on fusion technology, Rome (Italy), 14-18 Sep 1992). Order Number DE93627226. Source: OSTI; NTIS (US Sales Only); INIS.

This paper concerns the preliminary investigation of the thermal behaviour and of the afterheat removal capability of the water-cooled lithium-lead box-shaped DEMO blanket in case of Loss-Of-Coolant Accident (LOCA). The thermal behaviour of the outboard-segment first wall and breeder region has been determined in an hypothetical accidental situation where convection cooling of the outboard blanket is totally lost. The case of two separate water-cooling circuits has been considered, and three possible connection schemes have been analyzed. The minimum temperature increase has been obtained when a crossed inboard/outboard cooling-circuits connection is assumed (inboard segment-box and outboard breeder-box from one side, the reverse from the other side). In case of LOCA in the outboard breeder region, the obtained maximum temperature is 550 deg C reached after about 20 seconds. The corresponding thermal stresses remain below the allowed limit. On the contrary, if the LOCA happens in the outboard segment-box, the maximum temperature of 625 deg C is reached after 1 hour in the first wall and the thermal stresses are too high. Possible solutions are briefly discussed. A similar analysis has also been performed for a different water-cooled lithium-lead blanket concept, the cylindrical module concept. The comparison between the two concepts indicates that their thermal behaviour in case of LOCA is very similar, although the cylindrical modules concept reaches slightly higher temperatures.

25289 (CEA-CONF–11239) **Water-cooled lithium-lead box-shaped blanket concept for Demo: thermo-mechanical optimization and manufacturing sequence proposal.** Baraer, L. (CEA Centre d'Etudes de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Mecanique et de Technologie); Dinot, N.; Giancarli, L.; Proust, E.; Salavy, J.F.; Severi, Y.; Quintric-Bossy, J. CEA Centre d'Etudes de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Mecanique et de Technologie. 1992. [5p.] (CONF-920930–: 17. symposium on fusion technology, Rome (Italy), 14-18 Sep 1992). Order Number DE93627227. Source: OSTI; NTIS (US Sales Only); INIS.

The development of the water-cooled lithium-lead box-shaped blanket concept for DEMO has now reached the stage of thermo-mechanical optimization. In the previous design phases the preliminary dimensioning of the cooling circuit has permitted to define the water proportions required in the breeder region and to demonstrate, after a minimization of steel proportion and thicknesses, that this concept could reach tritium breeding self-sufficiency. In the present analysis the location of the coolant pipes has been optimized for the whole equatorial plane cross-section of both inboard and outboard segments in order to maintain the maximum Pb-17Li/steel interface temperature below 480 deg C and to minimize the thermal gradients along the steel structures. The consequent thermo-mechanical analysis has shown that the thermal

stresses always remain below the allowable limits. Segment fabricability and removal are the next design issues to be analyzed. Within this strategy, a first manufactury sequence for the outboard segment is proposed.

25290 (CEA-CONF–11240) **Breeding blanket for Demo.** Proust, E. (CEA Centre d'Etudes de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Mecanique et de Technologie); Giancarli, L.; Anzidei, L.; Casini, G.; Dalle Donne, M.; Malang, S. CEA Centre d'Etudes de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Mecanique et de Technologie. 1992. [13p.] (CONF-920930–: 17. symposium on fusion technology, Rome (Italy), 14-18 Sep 1992). Order Number DE93627228. Source: OSTI; NTIS (US Sales Only); INIS.

This paper presents the main design features, their rationale, and the main critical issues for the development, of the four DEMO-relevant blanket concepts presently investigated within the framework of the European Test-Blanket Development Programme.

25291 (CEA-CONF–11241) **Further neutronic analyses of the European ceramic B.I.T. blanket for Demo.** Giancarli, L. (CEA Centre d'Etudes de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Mecanique et de Technologie); Diop, C.; Petrizzi, L.; Rado, V. CEA Centre d'Etudes de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Mecanique et de Technologie. 1992. [5p.] (CONF-920930–: 17. symposium on fusion technology, Rome (Italy), 14-18 Sep 1992). Order Number DE93627229. Source: OSTI; NTIS (US Sales Only); INIS.

The present study concerns the most recent neutronic analyses of two design versions of the european ceramic B.I.T. blanket, jointly developed by ENEA and CEA since few years. The last year developments required a new 3-D geometry evaluations of the global TBR (Tritium Breeding Ratio). The results indicated that the ENEA version reaches a global TBR value of 1.13. The CEA version, in a 3-D model using a simplified description of the breeder module layout, reaches a TBR value of 1.12. Nuclear heat deposition density has been determined for all blanket components as a function of the poloidal co-ordinate. Shielding properties of this type of blanket have been analyzed.

25292 (CONF-9301106–1) **Looking beyond ITER: Toroidal concept improvement.** Sheffield, J. Oak Ridge National Lab., TN (United States). [1993]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From Fusion Power Associates annual meeting; La Jolla, CA (United States); 28-29 Jan 1993. Order Number DE93012762. Source: OSTI; NTIS; INIS; GPO Dep.

The International Thermonuclear Experimental Reactor (ITER) will demonstrate ignition and undertake fusion reactor systems integration and testing. Its design will be based upon relatively conservative physics assumptions. More attractive reactor configurations than those based upon ITER physics and the ITER configuration appear possible. The Toroidal Physics Experiment (TPX) will study tokamak behavior under a variety of conditions which may allow operation of improved combinations of beta, transport, and recirculating power. However, TPX still retains a configuration similar to ITER. Two alternative approaches appear interesting, based upon recent experimental results: the very low aspect ratio tokamak, or spherical torus, and the stellarator.

25293 (CONF-9303153–1) **ITER EDA design confinement capability.** Uckan, N.A. Oak Ridge National Lab., TN (United States). [1993]. 21p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From International thermonuclear experimental reactor meeting; Atlanta, GA (United States); 10 Mar 1993. Order Number DE93013729. Source: OSTI; NTIS; INIS; GPO Dep.

Major device parameters for ITER-EDA and CDA are given in this paper. Ignition capability of the EDA (and CDA) operational scenarios is evaluated using both the 1-1/2-D time-dependent transport simulations and 0-D global models under different confinement [$\chi(\nabla T_e)_{crit}$, empirical global energy confinement scalings, χ(empirical), etc.] assumptions. Results from some of these transport simulations and confinement assessments are summarized in and compared with the ITER CDA reference ignition scenario.

25294 (CONF-9304112–6) **Arc detection and protection in high-power antenna systems.** Caughman, J.B.O.; Hoffman, D.J. Oak Ridge National Lab., TN (United States). [1993]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 10. topical conference on radio frequency power in plasmas; Boston, MA (United States); 1-3 Apr 1993. Order Number DE93013272. Source: OSTI; NTIS; INIS; GPO Dep.

In an effort to establish a criteria for determining the presence of an arc in an antenna system, the change in the input reflection coefficient caused by an arc of arbitrary impedance and location has been calculated for two representative antenna systems. The antenna systems that have been studied are a resonant double loop antenna system (Tore Supra, TFTR) and a coupled four-strap antenna system (DIII-D). The amount of power that is coupled into an arc as a function of the reflection coefficient and arc impedance has been calculated. Results of the calculation have shown that up to fifty percent of the forward power can be coupled to an arc, when the measured reflection coefficient is 0.5 and up to ten percent of the forward power can be coupled to an arc when the reflection coefficient is 0. 1, depending on the impedance and location of the arc and the particular antenna system. The calculations have shown that changes in the magnitude of the reflection coefficient caused by an arc are, often accompanied by changes in voltage ratios on the same current strap or between different straps and by changes in the phase angles of the voltages and/or the reflection coefficient. Recommendations for the use of voltage magnitude and phase detectors as a diagnostic for arc detection and protection are made.

25295 (CONF-9304112–7) **Power compensators for phased operation of antenna arrays on JET and DIII-D.** Goulding, R.H. (Oak Ridge National Lab., TN (United States)); Hoffman, D.J.; Ryan, P.M.; Bosia, G.; Bures, M.; Start, D.; Wade, T.; Petty, C.C.; Pinsker, R.I. Oak Ridge National Lab., TN (United States). [1993]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 10. topical conference on radio frequency power in plasmas; Boston, MA (United States); 1-3 Apr 1993. Order Number DE93013208. Source: OSTI; NTIS; INIS; GPO Dep.

A system has been designed to allow operation of the JET A2 antenna arrays with phasing between elements of other than 0 or π at increased power. The system uses a hybrid coupler to transfer power in the direction opposite to that occurring at the antenna elements. This results in nearly equal currents and voltages on the feed lines and antenna structures, with nearly equal input powers at the rf generators. The direction and magnitude of the power transfer is controlled by adjustable tuning elements mounted on two of the four coupler ports. Much insight has been gained on optimization of the circuit design to maximize bandwidth (~10 MHz for the present JET design with 20 MHz a possibility) and power-handling capability. The concept has been tested initially on the DIII-D tokamak, with a compensator installed in the feed circuit for the four-element FWCD antenna array. In this application it acts to equalize input impedances, and will eventually be used to allow operation with multiple transmitters.

25296 (CONF-9304112–8) **Electrical characterization of the JET A_2 antenna: Comparison of model with measurements.** Ryan, P.M. (Oak Ridge National Lab., TN (United States)); Goulding, R.H.; Bhatnagar, V.; Kaye, A.; Wade, T. Oak Ridge National Lab., TN (United States). [1993]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 10. topical conference on radio frequency power in plasmas; Boston, MA (United States); 1-3 Apr 1993. Order Number DE93012964. Source: OSTI; NTIS; INIS; GPO Dep.

The JET experiment is replacing its previous (AI) antennas with upgraded designs (A2) for its upcoming "pumped diverter" operation. These antennas are more directional than the previous two-strap AI antennas when operated as a phased array. The frequency range is 23 to 57 MHz. A full-scale low power "flat" mockup was tested at JET; strap lengths were adjusted to give balanced operation with resonance at 42 MHz. A second mockup module, differing only slightly from the original, was subsequently fabricated and both modules were sent to ORNL for additional measurements and to test the operation of the power compensator circuit. There

are benefits to using a transmission line model to characterize coupled antenna systems, primarily in the ease of incorporating the antennas into the overall analysis of the transmission, tuning, and matching system. The characteristics of the array under arbitrary phasing are also needed for the design, analysis, and control of the power compensator. There are aspects of the JET A2 antenna geometry that differ considerably from previously modeled cases. Each transmission line feeds two poloidally-stacked straps connected in parallel. The parallel straps present different electrical loads at the match point due to geometrical differences. Currents in one section of the strap influence other sections of the same strap as well as in neighboring straps due to internal inductive coupling. The lengths of the inner and outer straps differ; moreover, the inner straps are fed from ports located behind the outer straps, resulting in increased coupling between the inner and outer straps due to the long feed lines and in greater disparity between the electricai loads presented at the inner and outer feed ports. The present effort is to determine whether a more general coupled transmission line model can characterize the array response with sufficient accuracy for the purpose of design and analysis.

25297 (CONF-9304112–9) **Design of the ion cyclotron system for TPX.** Swain, D. (Oak Ridge National Lab., TN (United States)); Shipley, S.; Yugo, J.; Goulding, R.; Batchelor, D.; Stallings, D.; Fredd, E. Oak Ridge National Lab., TN (United States). [1993]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 10. topical conference on radio frequency power in plasmas; Boston, MA (United States); 1-3 Apr 1993. Order Number DE93012961. Source: OSTI; NTIS; INIS; GPO Dep.

The TPX experiment will operate for very long pulse times ($\geq$ 1000 s) and will require current drive of several different types to explore the advanced physics operating modes as one of its main missions. Fast wave current drive (FWCD) using ion cyclotron waves in the 40–80 MHz range will be used as one of the main current-drive mechanisms. For initial operation, 8 MW of rf will be supplied, along with 8 MW of neutral beams and 1.5 MW of lower hybrid power. The ion cyclotron (IC) system is a major part of the TPX heating and current drive system. The IC system must: supply 8 MW of power through two main horizontal ports; be upgradable to provide up to 12 MW of rf power through two ports; operate, for 1000-s pulses every 75 min; drive current using FWCD with high reliability; be bakeable to 350°C for cleaning; and incorporate shielding to attenuate the neutron and gamma flux from DD operation so that hands-on maintenance can be performed exterior to the vacuum vessel. The system will consist of four modified FMIT power units that will be upgraded to deliver 2 MW each to the plasma. Two antennas, each with six current straps, will be located in adjacent ports. A sophisticated matching system is needed to provide experimental flexibility and reliability.

25298 (CONF-9304112–12) **Effect on antenna structure of high power rf during plasma operation.** Haste, G.R. (Oak Ridge National Lab., TN (United States)); Thomas, C.E.; Fadnek, A.; Carter, M.D.; Beaumont, B.; Becoulet, A.; Kuus, H.; Saoutic, B. Oak Ridge National Lab., TN (United States). [1993]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 10. topical conference on radio frequency power in plasmas; Boston, MA (United States); 1-3 Apr 1993. Order Number DE93013278. Source: OSTI; NTIS; INIS; GPO Dep.

High-power, long-pulse operation on the Tore Supra tokamak results in considerable stress on the plasma-facing components. The ICH antennas must deliver high-power rf(up to 4 MW per antenna) in this environment. The antenna structure is therefore subjected to the power flux resulting from the interaction between rf and the edge plasma. The structure's response during operation is described, as is the condition of the antenna after prolonged use.

25299 (DOE/DP–0110P) **Tritium consolidation comparison study: Cost analysis.** USDOE, Washington, DC (United States). Dec 1992. 83p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93007431. Source: OSTI; NTIS; GPO Dep.

In February 1991 the Department of Energy released the Nuclear Weapons Complex Reconfiguration Study. As a part of the planning for this effort the Department released the Nonnuclear Consolidation Plan (NCP) to analyze alternatives on how best to achieve the preferred option of consolidating nonnuclear activities at a single site. This plan compared six plants - Kansas City, Mound, Pinellas, Rocky Flats, Y-12 and Pantex - as possible nonnuclear consolidation sites. Based upon analysis of this plan the Department announced that an Environmental Assessment would be prepared on the preferred alternative of consolidating most of the activity at the Kansas City Plant with some work relocated to other sites. The tritium activity at the Mound Plant (MP) would be transferred to the Savannah River Site (SRS) where significant other tritium activity is conducted. This "Tritium Consolidation Comparison Study: Cost Analysis" was prepared to ascertain the relative cost advantage of locating the tritium activity at either the MP or the SRS. This study compares the costs and schedules for tritium reservoir filling, emptying, surveillance, and processing activities to be performed at the MP and the SRS with the alternative of consolidating. these activities at each of these two sites. For reference purposes this study also sets forth the projected costs of taking no action to reconfigure which would leave both plants operating. The scope of work estimated is for a steady-state weapons workload based on Planning and Production Directive 92-1A. The study found that either site could perform the mission with additional resources. The MP could support an operational date for all requirements in late 1996 while the SRS date would be late 1997.

25300 (DOE/EH–0316) **Report on the oversight assessment of the operational readiness review of the Replacement Tritium Facility at Savannah River Site.** Lee, B.T. USDOE Assistant Secretary for Environment, Safety, and Health, Washington, DC (United States). Mar 1993. 24p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93011223. Source: OSTI; NTIS; GPO Dep.

This report presents the results of an oversight assessment (OA) conducted by the US Department of Energy's (DOE) Office of Environment, Safety and Health (EH) of operational readiness review (ORR) activities for the Replacement Tritium Facility (RTF) located at Savannah River Site (SRS). The EH OA of this facility took place concurrently with an ORR conducted by the DOE Office of Defense Programs (DP). The DP ORR was conducted from January 19 through February 5, 1993. The EH OA was performed in accordance with the protocol and procedures specified in "EH Program for Oversight Assessment of Operational Readiness Evaluations for Startups and Restarts," dated September 15, 1992. The EH OA Team evaluated the DP ORR to determine whether it was thorough and demonstrated sufficient inquisitiveness to verify that the implementation of programs and procedures adequately ensures the protection of worker safety and health. The EH OA Team performed its evaluation of the DP ORR in the following technical areas: occupational safety, industrial hygiene, and respiratory protection; fire protection; and chemical safety. In the areas of fire protection and chemical safety, the EH OA Team conducted independent vertical-slice reviews to confirm DP ORR results. Within each technical area, the EH OA Team reviewed the DP ORR Plan, including the Criteria Review and Approach Documents (CRADs); the qualifications of individual DP ORR team members; the performance of planned DP ORR activities; and the results of the DP ORR.

25301 (DOE/ER–0313/13) **Fusion reactor materials semiannual progress report for period ending September 30, 1992.** Oak Ridge National Lab., TN (United States). [1992]. 378p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. (ORNL/M–2722). Order Number DE93013462. Source: OSTI; NTIS; INIS; GPO Dep.

This report contains papers on the following topics on thermonuclear reactor materials: irradiation facilities, test matrices, and experimental methods; dosimetry, damage parameters,and activation calculations; radiation effects, mechanistic studies, theory and modeling; development of structural alloys; solid breeding materials and beryllium; and ceramics. These reports have been index separately elsewhere.

25302 (DOE/ER/53098–T9) **Theory of field-reversed configurations: Final report.** Steinhauer, L.C. STI Optronics, Bellevue, WA (United States). 29 Jan 1993. 24p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-80ER53098. Order Number DE93015611. Source: OSTI; NTIS; INIS; GPO Dep.

This report summarizes results from the theoretical program on field reversed configurations (FRC) at STI Optronics. The program, which has spanned the last 13 years, has included analytical as well as computational components. It has led to published papers on every major topic of FRC theory. The report is outlined to summarize results from each of these topic areas: formation, equilibrium, stability, and confinement. Also briefly described are Steinhauer's activities as Compact Toroid Theory Listening Post. Appendix A is a brief listing of the major advances achieved in this program. Attached at the back of this report is a collection of technical papers in archival journals that resulted from work in this program. The discussion within each subsection is given chronologically in order to give a historical sense of the evolution of understanding of FRC physics.

25303 (DOE/FTR–93012118) **[Travel by Plasma Fusion Center personnel to attend conferences in Austria, Belgium, and Germany concerning plasma and fission physics]: Foreign trip report, June 27, 1992–July 11, 1992.** Porkolab, M. Massachusetts Inst. of Tech., Cambridge, MA (United States). Plasma Fusion Center. [1992]. 29p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-91ER54110. Order Number DE93012118. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Summaries of topics discussed at the following three meetings are given: (i) Joint meeting of the 1992 ICPP International Conference on Plasma Physics 19th EPS conf. on Controlled Fusion and Plasma physics and the 9th Kiev International Conference on Plasma theory, at Innsbruck, Austria, (June 29–July 3); (ii) Europhysics topical Conference on Radiofrequency Heating and current Drive of fusion Devices, Brussels, Belgium, 1992 (July 7–10, 1992); and (iii) Visit/attend ASDEX-UPGRADE workshop on ICRF heating (Ringberg Castle, Germany)(July 6, 1992).

25304 (DOE/FTR–93012977) **[Initiate an experimental and modeling collaboration with Russian scientists on hydrogen isotope retention and release from plasma- facing materials]: Foreign trip report, June 29–July 10, 1992.** Bastasz, R. Sandia National Labs., Livermore, CA (United States). [1992]. 19p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. Order Number DE93012977. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report summarizes the authors participation in the 1992 US/Russian Federation exchange I.3("Joint Work: Hydrogen Isotope Retention, Remission") in fusion energy research. It describes various aspects of fusion research (primarily in the areas of plasma-surface interactions and plasma-facing materials development) at the Russian institutes TRINITI, IPC, and MEPI. Several areas of mutual interest and potential collaboration are discussed.

25305 (DOE/FTR–93013553) **[Travel to Germany to participate in the ITER meeting on divertor and first wall]: Foreign trip report, June 22–July 1, 1992.** Gauster, W.B. Sandia National Labs., Albuquerque, NM (United States). 20 Jul 1992. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. Order Number DE93013553. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Summaries of the sessions on Materials R&D of the ITER Meeting on Divertor and First Wall are given.

25306 (EGG-M–92627) **Failure rate data for fusion safety and risk assessment.** Cadwallader, L.C. EG and G Idaho, Inc., Idaho Falls, ID (United States). [1993]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-76ID01570. (CONF-930243–6: Data banks for risk assessment workshop, Augusta, GA (United States), 2-3 Feb 1993). Order Number DE93010807. Source: OSTI; NTIS; INIS; GPO Dep.

The Fusion Safety Program (FSP) at the Idaho National Engineering Laboratory (INEL) conducts safety research in materials, chemical reactions, safety analysis, risk assessment, and in component research and development to support existing magnetic fusion experiments and also to promote safety in the design of future experiments. One of the areas of safety research is applying probabilistic risk assessment (PRA) methods to fusion experiments. To apply PRA, we need a fusion-relevant radiological dose code and a component failure rate data base. This paper describes the FSP effort to develop a failure rate data base for fusion-specific components.

25307 (INDC(NDS)–237/M6) **IAEA consultants' meeting on thermal response of plasma facing materials and components: Summary report.** Janev, R.K. International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Jul 1990. [15p.] (CONF-9006441–: IAEA consultants' meeting on thermal response of plasma facing materials and components, Vienna (Austria), 11-13 Jun 1990). Order Number DE93627134. Source: OSTI; NTIS (US Sales Only); INIS.

The present Summary Report contains brief proceedings and the main conclusions and recommendations of the IAEA Consultants' Meeting on "Thermal Response of Plasma Facing Materials and Components", which was organized by the IAEA Atomic and Molecular Data Unit and held on June 11-13, 1990, in Vienna, Austria. The Report also includes a categorization and assessment of currently studied plasma facing materials, a classification scheme of material properties data, required in fusion reactor design, and a survey of the urgently needed material properties data. (author).

25308 (INDC(NDS)–264/G) **Summary report of the IAEA advisory group meeting on nuclear data for neutron multiplication in fusion-reactor first-wall and blanket materials.** Muir, D.W. (International Atomic Energy Agency, Vienna (Austria). Nuclear Data Section); Pashchenko, A.B. International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Sep 1992. [28p.] (CONF-9011327–: IAEA advisory group meeting on nuclear data for neutron multiplication in fusion-reactor first-wall and blanket materials, Chengdu (China), 19-21 Nov 1990). Order Number DE93627252. Source: OSTI; NTIS (US Sales Only); INIS.

The present Report contains the Summary of the IAEA Advisory Group Meeting on Nuclear Data for Neutron Multiplication in Fusion-Reactor First-Wall and Blanket Materials, which was hosted by the Southwest Institute of Nuclear physics and Chemistry (SWINPC) at Chengdu, China and held from 19-21 November 1990. This AGM was organized by the IAEA Nuclear Data Section (NDS), with the cooperation and assistance of local organizers at the SWINPC. The papers which the participants prepared for and presented at the meeting will be published as an INDC report. (author).

25309 (INIS-JP–007, pp. 245-250) **Evaluation of high energy intense neutron source concepts for fusion materials testing.** Noda, K. (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Tokai Research Establishment). Japan Atomic Energy Research Inst., Tokyo (Japan). 1992. 817p. (CONF-911154–: International conference on evolution in beam applications, Takasaki (Japan), 5-8 Nov 1991). In *Proceedings of the international conference on evolution in beam applications.* Order Number DE93703820. Source: OSTI; NTIS; INIS.

Fusion materials testing and development cannot be achieved without a high energy intense neutron source which simulates the fusion reactor neutron environment. Criteria of suitability for a fusion materials irradiation test facility fulfilling the world-wide demand, so-called 'International Fusion Material Irradiation Facility' (IFMIF), were defined in an IEA activity on fusion materials research and development (R and D). Several concepts of IFMIF candidates were proposed. Furthermore, a concept of high energy neutron irradiation facility named 'Energy Selective Neutron Irradiation Test Facility' (ESNIT) was conceived at Japan Atomic Energy Research Institute (JAERI) as a facility for materials researches in generic nuclear applications of which major potential research incentives were originated from nuclear fusion application. In this paper, current evaluation of suitability of various IFMIF and ESNIT concepts for fusion material irradiation testing and their technological feasibility and so on is described. (author).

25310 (INIS-JP–007, pp. 340-345) **Intense positive and negative ion sources for fusion applications.** Okumura, Y. (Japan Atomic Energy Research Inst., Naka, Ibaraki (Japan). Naka Fusion Research Establishment). Japan Atomic Energy Research Inst., Tokyo (Japan). 1992. 817p. (CONF-911154–: International conference on evolution in beam applications, Takasaki (Japan), 5-8 Nov 1991). In *Proceedings of the international conference on evolution*

in beam applications. Order Number DE93703820. Source: OSTI; NTIS; INIS.

Technologies producing intense positive and negative ion beams have been highly developed in these two decades for fusion applications; e.g. heating the thermonuclear fusion plasmas by intense neutral beams, beam diagnostics of the plasma, etc. At present, it is possible to produce several tens of ampere positive ion beams continuously at beam energies of 100-200 keV with good beam optics. Recently, negative ion source have also been developed for next generation fusion experiments. Multi-ampere H^-/D^- ion beams have been successfully produced and R and D's to increase the beam energy up to 0.5-1 MeV are now in progress. (author).

25311 (INIS-JP–007, pp. 368-373) **Generation and acceleration of highly ionized metallic ions with the 'point pinch diode'.** Sato, M. (Himeji Inst. of Tech., Hyogo (Japan)); Tazima, T. Japan Atomic Energy Research Inst., Tokyo (Japan). 1992. 817p. (CONF-911154–: International conference on evolution in beam applications, Takasaki (Japan), 5-8 Nov 1991). In *Proceedings of the international conference on evolution in beam applications.* Order Number DE93703820. Source: OSTI; NTIS; INIS.

Intense pulsed ion beams have been studied as an energy driver for inertial confinement fusion. However the ion beams have been recently utilized to development of new materials. The 'Point Pinch Diode' which consists of a small spherical cathode and a flat anode has been also used to study for inertial confinement fusion. In this diode, it was reported that the generated ion beam contained significant amounts of highly ionized metallic ions which were produced from anode materials. Taking into account of utilization as an ion source, we investigated the characteristics of the ion beam generated with the 'Point Pinch Diode'. From the experimental results, it was made clear that the generated pulsed ion beams contained large amounts of highly ionized metallic ions (e.g. $Cu^{2+} \approx Cu^{6+}$, $Mo^{2+} \approx Mo^{9+}$, $W^{3+} \approx W^{17+}$, $Pb^{7+} \approx Pb^{17+}$), even though the ion beams contained considerably the light ions (e.g. H^+, $C^+ \approx C^{5+}$, $0^+ \approx 0^{5+}$). Here the acceleration voltage for these ions were 300≈400 kV. The current densities of the ion beams measured at 190 mm from the top of the spherical cathode were 10≈20 A/cm^2. (author).

25312 (INIS-JP–007, pp. 379-382) **Characteristics of a new microwave ion source for plasma-wall interaction studies.** Tokiguchi, K. (Hitachi Ltd., Ibaraki (Japan). Hitachi Research Lab.); Gotoh, Y.; Yamaki, T.; Amemiya, K. Japan Atomic Energy Research Inst., Tokyo (Japan). 1992. 817p. (CONF-911154–: International conference on evolution in beam applications, Takasaki (Japan), 5-8 Nov 1991). In *Proceedings of the international conference on evolution in beam applications.* Order Number DE93703820. Source: OSTI; NTIS; INIS.

A new microwave ion source for plasma-wall interaction studies was designed and an irradiation apparatus containing the source was constructed. The source efficiently produced H_3^+ or D_3^+ ions through the ion-molecule reaction between H_2^+ (D_2^+) ions and H_2 (D_2) molecules in the ion source plasma chamber. The mass-analyzed H_3^+ ion current reached 1.5 mA at an extraction voltage of 3 kV. The beam diameter was about 1 cm. The irradiation flux density of hydrogen atoms at an energy of 1 keV exceeded 4 x 10^{16} atoms/cm^2·s, which is high enough for plasma-wall interaction studies. (author).

25313 (INIS-JP–007, pp. 692-695) **Thermal shock tests of carbon materials with high power beam.** Akiba, M. (Japan Atomic Energy Research Inst., Naka, Ibaraki (Japan). Naka Fusion Research Establishment); Araki, M.; Ando, T.; Jinbou, R.; Saidoh, M.; Suzuki, S.; Nakamura, K.; Tanaka, S. Japan Atomic Energy Research Inst., Tokyo (Japan). 1992. 817p. (CONF-911154–: International conference on evolution in beam applications, Takasaki (Japan), 5-8 Nov 1991). In *Proceedings of the international conference on evolution in beam applications.* Order Number DE93703820. Source: OSTI; NTIS; INIS.

In tokamak machines, not only present machine but also future tokamak devices, off-normal events, so called plasma disruption, is considered as unavoidable phenomena. During the plasma disruption, plasma energy will deposit onto the surface of plasma facing components (PFC). Erosion induced by the disruption will be considered as primary limitation factor of life time of the PFCs. To evaluate erosion rate during the disruption, high power beam facilities have strongly been required. JAERI constructed an electron beam test facility to simulate the disruption heat load. The facility can produce an intense electron beam at a heat flux of up to 2000 MW/m^2 from 1 ms. Many carbon based materials, which have regarded at most promising armor materials, have been tested at the facility at a heat flux range from 300 MW/m^2 to 2000 MW/m^2. The erosion depth of carbon-fiber-carbon composites (C/C composites) is ≈ 3 times larger than that of numerical prediction. Carbon based B_4C-coated and B_4C converted materials which have been developed at JAERI have also tested in the facility. The B_4C converted C/C composites show high thermal shock resistance. (author).

25314 (JAERI-M–92-183) **Phase IIC experiments of the USDOE/JAERI collaborative program on fusion blanket neutronics: Experiments and analysis of heterogeneous fusion blankets, volume II: analysis.** Youssef, M.Z. (ed.) (California Univ., Los Angeles, CA (United States)). Japan Atomic Energy Research Inst., Tokyo (Japan). Dec 1992. 119p. (UCLA-FNT–64;UCLA-ENG–93-19). Order Number DE93788399. Source: OSTI; NTIS; INIS.

Effort in Phase IIC of the US/JAERI Collaborative Program on Fusion Neutronics was focused on performing integral experiments and post analyses on blankets that include the actual heterogeneities found in several blanket designs. Two geometrical arrangements were considered for the blanket assembly, namely multi-layers of Li_2O and beryllium in an edge-on, horizontally alternating configuration for a front depth of 30 cm, followed by the Li_2O breeding zone (Be edge-on, BEO, experiment), and vertical water coolant channels arrangement (WCC experiment). The objectives are to examine the accuracy of predicting tritium production. In the BEO system, it was shown that, with the zonal method to measure tritium production from natural lithium (Tn), the calculated-to-measured values (C/E) are 0.95-1.05 (JAERI) and 0.98-0.9 (U.S.), which is consistent with the results obtained in other Phases of the Program (Phases IIA and IIb). In the WCC experiment, there is a noticeable change in C/E values for T_6 near the coolant channels where steep gradients in T_6 production are observed. The C/E values obtained with the Li-foil detectors are on the average closer to unity than those obtained by the Li-glass method. As for T_7, the values obtained by NE213 method are within ±15% in JAERI's calculations, but larger values (≈20-25%) are obtained in the U.S. calculations due to the differences of cross-sections data files. Around heterogeneities, the prediction accuracy for T_7 is better than for T_6. (J.P.N.).

25315 (LALP–93-17) **High-energy density physics at Los Alamos.** Byrnes, P. (ed.); Younger, S.M. Los Alamos National Lab., NM (United States). Mar 1993. 27p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. Order Number DE93010271. Source: OSTI; NTIS; INIS; GPO Dep.

This brochure describes the facilities of the Above Ground Experiments II (AGEX II) and the Inertial Confinement Fusion (ICF) programs at Los Alamo. Combined, these programs represent, an unparalleled capability to address important issues in high-energy density physics that are critical to the future defense, energy, and research needs of th e United States. The mission of the AGEX II program at Los Alamos is to provide additional experimental opportunities for the nuclear weapons program. For this purpose we have assembled at Los Alamos the broadest array of high-energy density physics facilities of any laboratory in the world. Inertial confinement fusion seeks to achieve thermonuclear burn on a laboratory scale through the implosion of a small quantity of deuterium and tritium fuel to very high Pressure and temperature.The Los Alamos ICF program is focused on target physics. With the largest scientific computing center in the world, We can perform calculations of unprecedented sophistication and precision. We field experiments at facilities worldwide-including our own Trident and Mercury lasers-to confirm our understanding and to provide the necessary data base to proceed toward the historic goal of controlled fusion in the laboratory. In addition to direct programmatic high-energy density physics is a nc scientific endeavor in itself. The ultrahigh magnetic fields produced in our high explosive pulsed-power generators can be used in awide variety of solid

state physics and temperature superconductor studies. The structure and dynamics of planetary atmospheres can be simulated through the compression of gas mixtures.

25316 (ORNL/TM–12264) **Multiple Antenna Implementation System (MAntIS).** Carter, M.D.; Batchelor, D.B.; Jaeger, E.F. Oak Ridge National Lab., TN (United States). Jan 1993. 33p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93012515. Source: OSTI; NTIS; INIS; GPO Dep.

The MAntIS code was developed as an aid to the design of radio frequency (RF) antennas for fusion applications. The code solves for the electromagnetic fields in three dimensions near the antenna structure with a realistic plasma load. Fourier analysis is used in the two dimensions that are tangential to the plasma surface and backwall. The third dimension is handled analytically in a vacuum region with a general impedance match at the plasma-vacuum interface. The impedance tensor is calculated for a slab plasma using the ORION-ID code with all three electric field components included and warm plasma corrections. The code permits the modeling of complicated antenna structures by superposing currents that flow on the surfaces of rectangular parallelepipeds. Specified current elements have feeders that continuously connect the current flowing from the ends of the strap to the feeders. The elements may have an arbitrary orientation with respect to the static magnetic field. Currents are permitted to vary along the length of the current strap and feeders. Parameters that describe this current variation can be adjusted to approximately satisfy boundary conditions on the current elements. The methods used in MAntIS and results for a primary loop antenna design are presented.

25317 (PPPL–2879) **Simulations of beam-fueled supershot-like plasmas near ignition.** Budny, R.V. (Princeton Univ., NJ (United States). Plasma Physics Lab.); Grisham, L.; Jassby, D.L.; Manickam, J.; Mikkelsen, D.; McCune, D.; McGuire, K.M.; Scott, S.D.; Stotler, D.; Wieland, R.; Zarnstorff, M.C.; Zweben, S.J.; Sabbagh, S.A. Princeton Univ., NJ (United States). Plasma Physics Lab. Mar 1993. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03073. (CONF-9206247–2: 19. European Physical Society (EPS) conference on controlled fusion and plasma physics, Innsbruck (Austria), 29 Jun - 4 jul 1992). Order Number DE93011498. Source: OSTI; NTIS; INIS; GPO Dep.

Centrally peaked profiles would be advantageous for tokamak reactors since the pressure and the bootstrap current would be peaked in the regions of intense reactivity. We use the TRANSP plasma analysis code to investigate the feasibility of fueling with neutral beam injection. We show that for certain conditions, neutral beams with energies less than 120 keV can penetrate into the cores of plasmas that have a large thermonuclear yield and Q_{DT} ~10. This value of ODT is too small for an economical reactor if the neutral beam injection is the only fueling source. We give examples for several proposed compact prototype reactor designs.

25318 (UCRL-CR–109549) **Gas dynamics in the central cavity of HYLIFE-II reactor.** Chen, X.M.; Schrock, V.E.; Peterson, P.F.; Colella, P. Lawrence Livermore National Lab., CA (United States). 10 Mar 1992. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-920607–22: 10. topical meeting on technology of fusion energy, Boston, MA (United States), 7-12 Jun 1992). Order Number DE93009322. Source: OSTI; NTIS; INIS; GPO Dep.

In a HYLIFE-II ICF reactor, the microfusion of the D-T capsule in the center of the chamber produces X-rays that can ablate a thin layer off the liquid blanket which protects the first structural wall Thisablated material will implode toward the center line of the central cavity due to the initial vacuum and cylindrical geometry, and then rebound back to the liquid blanket vent through it and exert a pressure "impulse" onto the structural wall. The initial ablation occurs in a very short period with very small characteristic length and the implosion and rebounding processes feature very high pressures and temperatures. The proper design of the chamber relies on the reasonably accurate analysis of the gas dynamics in the central cavity and the gas-liquid interaction. In this paper, a second order Godunov numerical method is used to solve the compressible flow equations in the central cavity. The rarefaction and shock phenomena are very well captured by the numerical calculation. The equation of state for Flibe vapor is used in the calculation along with the parameters for the HYLIFE-II design. Since the radiation transport has not yet been included in the current calculations, the vapor possesses higher energy and therefore temperature. The total mass vaporized will also be underestimated in the later time of the calculation. The incorporation of a radiation calculation into this code is our next goal.

25319 (UCRL-ID–111589) **Heat load analysis on the cable-in-conduit with central core conductor for the TF coil Rebut layer design.** Long, A.E. (Massachusetts Inst. of Tech., Cambridge, MA (United States)). Lawrence Livermore National Lab., CA (United States). 23 Sep 1992. 37p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE93013783. Source: OSTI; NTIS; GPO Dep.

The current Rebut Layer Design for the ITER TF coil calls for a cable-in-conduit with central core conductor, representing a break from the conventional configuration. In an effort to find the maximum heat load which this conductor can sustain without instigating quench, a model was developed to characterize the heat transfer behavior of the core. This model approximates the superconducting strands as double-sided fins exposed to two separate, parallel liquid helium flows. The model successfully predicts a reasonable value of maximum heat load, and yields results that compare well with a preliminary, computational analysis. The double-sided fin model also provides information on how such geometric parameters as core-to-cable space area ratio and strand winding angle can be adjusted to improve the heat transfer performance of the conductor. Experimental verification of the model is needed to insure compatibility with actual designs.

25320 (UCRL-ID–113500) **Seismic upgrade of the Nova capacitor bank.** Tietbohl, G.L. (Lawrence Livermore National Lab., CA (United States)); Patel, C.S. Lawrence Livermore National Lab., CA (United States). 5 Apr 1993. 26p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE93014368. Source: OSTI; NTIS; GPO Dep.

The main capacitor bank for the Nova laser system at Lawrence Livermore National Laboratory was found to be seismically unsafe after the 1989 Loma Prieta earthquake. A method of strengthening the bank was developed, which satisfied the current seismic design criteria and minimized the downtime of the laser system during installation. Before implementation, the design was analyzed by finite element methods and the building was checked for load capacity. The bank is now upgraded to current seismic standards.

25321 (UCRL-JC–110-843) **Simulations of DIII-D divertor biasing with the LEDGE code.** Rensink, M.E.; Milovich, J.; Rognlien, T. Lawrence Livermore National Lab., CA (United States). Sep 1992. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9209181–7: International Atomic Energy Agency (IAEA) technical committee meeting on tokamak plasma biasing, Montreal (Canada), 8-10 Sep 1992). Order Number DE93010500. Source: OSTI; NTIS; INIS; GPO Dep.

We use the LEDGE 2-d fluid model for the edge plasma to determine the effects of electrically biasing the outboard divertor plate in DIII-D. The LEDGE code includes classical perpendicular and parallel current flows as well as E x B and diamagnetic drifts. Boundary conditions at the divertor plates allow the sheath parameters to vary with current flow across the sheath. Ohmic heating and convective heat flow associated with the current flow are included. Neutrals originating at the divertor plates due to recycling are represented by a fluid model. We explore the effect of cross-field drifts and variations in the bias voltage. The current-voltage characteristic, inboard/outboard heat flux asymmetry and radial plasma profiles are computed. We show that cross-field drifts have a strong effect on the plasma profiles at the diverter plates. Differential biasing of the inboard and outboard divertor plates can significantly modify the naturally occurring outboard/inboard heat flux asymmetry, but only weakly affects radial profiles at the outboard plate.

25322 (UCRL-JC–107242) **ETA-II accelerator upgrades.** Nilson, D.G.; Deadrick, F.J.; Hibbs, S.M.; Sampayan, S.E.; Petersen, D.E. Lawrence Livermore National Lab., CA (United States). Sep 1991. 6p. Sponsored by USDOE, Washington, DC (United States).

DOE Contract W-7405-ENG-48. (CONF-910968–81: 14. IEEE symposium on fusion engineering, San Diego, CA (United States), 30 Sep - 3 oct 1991). Order Number DE93012490. Source: OSTI; NTIS; INIS; GPO Dep.

We discuss recent improvements to the ETA-II linear induction electron accelerator. The accelerator's cells have been carefully reconditioned to raise the maximum accelerating gap voltage from approximately 100 kV to 125 kV. Insulators of Rexolite plastic in a new "zero-gap" arrangement replaced the alumina originals after several alternative materials were investigated. A new multi-cable current feed system will be used to eliminate pulse reflection interactions encountered in earlier experiments. Improved alignment fixtures have been installed to help minimize beam perturbation due to poorly aligned intercell magnets between 10-cell groups. A stretched wire alignment technique (SWAT) has been utilized to enhance overall magnetic alignment, and to characterize irreducible alignment errors. These changes are in conjunction with an expansion of the accelerator from a 20-cell to a 60-cell configuration. When completed, the upgraded accelerator is expected to deliver 2.5 kA of electron beam current at 7.5 MeV in bursts of up to fifty 70-ns pulses at a 5-kHz repetition rate. A 5.5-meter-long wiggler will convert the energy into 3-GW microwave pulses at 140 GHz for plasma heating experiments in the Microwave Tokamak Experiment (MTX).

25323 (UCRL-JC–109253) **K- and L-shell x-ray spectroscopy of indirectly driven implosions.** Hammel, B.A. Lawrence Livermore National Lab., CA (United States). 7 Apr 1992. 23p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-920362–45: 9. topical conference on high-temperature plasma diagnostics, Santa Fe, NM (United States), 15-19 Mar 1992). Order Number DE93009245. Source: OSTI; NTIS; GPO Dep.

Time resolved x-ray spectroscopy is used to study the implosion of indirectly driven inertial confinement fusion capsules on the Nova laser. Through the use of high-Z dopants (Ar and Xe) in the fuel, measurements of the peak temperature, from emission line ratios, and density, from line broadening, are obtained. These measurements indicate peak electron temperatures of ~1–1.6 key and electron (and proton) densities in the range of 0.9–2.3 x 10^{24} cm^{-3}, depending on the type of laser drive used. The higher densities are achieved on targets that are driven with a shaped laser drive that allows a more isentropic compression of the fuel. Emission from high-Z pusher dopants has also been studied. These dopants can provide information on pusher conditions, and can be used to study mix at the pusher fuel interface.

25324 (UCRL-JC–109796) **Electrical characteristics of short pulse gated microchannel plate detectors.** Bell, P.M. (Lawrence Livermore National Lab., CA (United States)); Kilkenny, J.D.; Landen, O.L.; Hanks, R.L.; Bradley, D.K. Lawrence Livermore National Lab., CA (United States). 17 Mar 1992. 29p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-920362–47: 9. topical conference on high-temperature plasma diagnostics, Santa Fe, NM (United States), 15-19 Mar 1992). Order Number DE93012501. Source: OSTI; NTIS; GPO Dep.

Gating of microchannel plates (MCP) can produce shutter times of less than 40 ps. This is accomplished with high fidelity electronic circuitry and short pulse (sub 80 ps) high amplitude electronic drivers. Measurements have shown that the fidelity of the electrical circuitry is one of the limiting factors in producing shorter X-ray gating.

25325 (UCRL-JC–109811-Rev.1) **A "SUPERCODE" for systems analysis of tokamak experiments and reactors.** Haney, S.W. (Lawrence Livermore National Lab., CA (United States)); Barr, W.L.; Crotinger, J.A.; Perkins, L.J.; Solomon, C.J.; Chaniotakis, E.A.; Freidberg, J.P.; Wei, J.; Galambos, J.D.; Mandrekas, J. Lawrence Livermore National Lab., CA (United States). 4 Mar 1992. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48 ;FG05-87ER52141 ;AC05-84OR21400. (CONF-920772–2-Rev.1: Topical meeting on the technology of fusion energy, Boston, MA (United States), 7-12 Jul 1992). Order Number DE93012593. Source: OSTI; NTIS; INIS; GPO Dep.

A new code, named SUPERCODE, has been developed to fill the gap between currently available zero dimensional systems codes and highly sophisticated, multidimensional plasma performance codes. The former are comprehensive in content, fast to execute, but rather simple in terms of the accuracy of their physics and engineering models. The latter contain state-of-the-art plasma physics modeling but are limited in engineering content and are time consuming to run. The SUPERCODE upgrades the reliability and accuracy of systems codes by calculating the self consistent 1 1/2-D plasma evolution in a realistic engineering environment. By a combination of variational techniques and careful formulation there is only a modest increase in CPU time over 0-D runs, thereby making the SUPERCODE suitable for use as a systems studies tool. In addition, we have expended considerable effort to make the code user- and programmer friendly, as well as operationally flexible, with the hope of encouraging wide usage throughout the fusion community.

25326 (UCRL-JC–109977) **Distributed absorption and inhibited heat transport.** De Groot, J.S. (California Univ., Davis, CA (United States)); Estabrook, K.G.; Kruer, W.L.; Drake, R.P.; Mizuno, K.; Cameron, S.M. Lawrence Livermore National Lab., CA (United States). 14 Feb 1992. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-911131–4: 10. international workshop on laser interaction and related plasma phenomena, Monterey, CA (United States), 11-15 Nov 1991). Order Number DE93009554. Source: OSTI; NTIS; GPO Dep.

A new self-consistent model is presented on the spatial structure of a laser heated planar, strongly absorbing plasma. Unlike previous models, this model explicitly includes the temporal evolution of the heat conduction region. It is shown that previous steady-state models apply only to a narrow range of the Parameters (laser energy flux and laser pulse width) that are used in laser pellet fusion. The new model is shown to agree with flux-limited hydrodynamics simulations. The key feature of the new model is a self-similar solution for the spatial profile of the temperature, density, and fluid velocity in the conduction region. It is shown that the sonic surface moves outward at a velocity of about 0.6 of the sound velocity. The most important result of the new model for laser pellet fusion is that the plasma properties at the sonic surface and most importantly the ablation pressure are independent of laser wavelength.

25327 (UCRL-JC–110000) **Three dimensional time-dependent hydrodynamic and propagation modeling of x-ray laser emission.** Ratowsky, R.P. (Lawrence Livermore National Lab., CA (United States)); Feit, M.D.; London, R.A.; Walling, R.S.; Shimkaveg, G.M.; Osterheld, A.L.; Carter, M.R.; Craxton, R.S. Lawrence Livermore National Lab., CA (United States). Jun 1992. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-920523–12: 3. international colloquium on x-ray lasers, Schliersee (Germany), 18-22 May 1992). Order Number DE93012575. Source: OSTI; NTIS; INIS; GPO Dep.

We have carried out three dimensional time-dependent calculations of x-ray emission in exploding foil line focus produced plasmas relevant to neon-like yttrium experiments at the Lawrence Livermore National Laboratory (LLNL). Hydrodynamic simulations using LASNEX and a simple gain profile based on XRASER are input into CASER, which solves the radiation transport equation along three dimensional ray orbits. Experimental observables such as farfield patterns and x-ray signal vs. laser length are then computed and compared with experiment. Similar two dimensional calculations have also been performed using the wave optics code WAVE to calculate coherence and confirm the accuracy of the ray optics treatment. We have found good agreement between both experiment and simulation and between the ray and wave optics codes.

25328 (UCRL-JC–110193) **Simulation of heavy ion fusion beams.** Friedman, A. (Lawrence Livermore National Lab., CA (United States)); Barnard, J.J.; Callahan, D.A.; Caporaso, G.J.; Chen, Y.J.; DeFord, J.F.; Grote, D.P.; Hewett, D.W.; Ho, D.D.M.; Langdon, A.B.; Payne, A.N.; Shang, C.C.; Sharp, W.M.; Shay, H.D.; Fawley, WLawrence Livermore National Lab., CA (United States). 10 Jul 1992. 15p. Sponsored by USDOE, Washington, DC (United States); Department of Defense, Washington, DC (United

States). DOE Contract W-7405-ENG-48 ;AC03-76SF00098. (CONF-9206235–6: International Atomic Energy Agency (IAEA) technical committee meeting on advances in simulation and modeling of thermonuclear plasmas, Montreal (Canada), 15-17 Jun 1992). Order Number DE93012578. Source: OSTI; NTIS; GPO Dep.

Beams of heavy ions generated by induction accelerators represent the principal driver approach in the US Office of Fusion Energy's Inertial Fusion Energy program. The technology appears to be well suited to the requirements of power production, enjoying advantages of efficiency, durability, repetition rate, and survivability of final optics. However, for inertial fusion applications the current is well above that found in conventional high energy physics accelerators, and the beams must be viewed as collisionless, non-neutral plasmas, confined by applied magnetic and electric fields. These space-charge-dominated beam-q must be focused onto small spots at the fusion target and so preservation of a small emittance is crucial. The nonlinear beam self-fields can lead to emittance growth, especially when the beam undergoes many manipulations, which may include: Transport through bends and imperfectly aligned focusing elements, non-steady acceleration, insertion into rings, merging, and splitting. Furthermore, beam formation and injection, and transport through the target chamber, are inherently plasma processes. Thus, a self-consistent field description is generally needed. Because of the beams' low plasma frequencies and short residence times, particle-in-cell techniques are particularly effective. This paper describes the variety of simulation techniques and codes used to model Heavy Ion Fusion beams. These range from simple envelope equation models to elaborate fluid and discrete-particle simulations in 1d, 2d and 3d. The Induction Linac Systems Experiments (ILSE) facility and experimental sequence proposed by the Lawrence Berkeley Laboratory has become the main thrust of the US program. We describe the simulation tools being applied to ILSE and to advanced accelerators, including recirculating induction accelerator concepts. We also describe the codes used to model beam sources and injectors, final focus, chamber transport, and interactions with the target corona.

25329 (UCRL-JC–110202) **Characterization of high-power RF structures using time-domain field codes.** Shang, C.C.; DeFord, J.F.; Swatloski, T.L. Lawrence Livermore National Lab., CA (United States). 21 Aug 1992. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9208109–82: 16. international LINAC conference, Ottawa (Canada), 23-28 Aug 1992). Order Number DE93013416. Source: OSTI; NTIS; INIS; GPO Dep.

We have modeled gyrotron windows and gyrotron amplifier sever structures for TE modes in the 100–150 GHz range and have computed the reflection and transmission characteristics from the field data. Good agreement with frequency domain codes and analytic analysis have been obtained for some simple geometries. We present results for realistic structures with lousy coatings and describe implementation of microwave diagnostics.

25330 (UCRL-JC–110329) **Laser-plasma instabilities and coherence control.** Baldis, H.A. (Lawrence Livermore National Lab., CA (United States)); Moody, J.D.; Montgomery, D.S.; Estabrook, K.G.; Berger, R.L.; Williams, E.A.; Kruer, W.L.; Lasinski, B.F.; Dixit, S.N.; Woods, B.; Henesian, M.A.; Hsieh, E.J.; Labaune, C.; Batha, S.H. Lawrence Livermore National Lab., CA (United States). 28 Aug 1992. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-920913–30: 14. international conference on plasma physics and controlled nuclear fusion research, Wuerzburg (Germany), 30 Sep - 7 oct 1992). Order Number DE93014117. Source: OSTI; NTIS; INIS; GPO Dep.

The authors experimentally investigate the effect of random phase plate (RPP) beam smoothing on Stimulated Brillouin Scattering (SBS) backscattered light in exploding foil plasmas. The experiments consist of measuring the backscattered SBS emission excited by an unsmoothed and a RPP smoothed interaction beam impinging on a preformed plasma. A Ti or CH plasma is preformed with typically 2500 J of 0.527 μm RPP smoothed laser light with a square pulse of 1 ns. The interaction laser focuses on the center of the preformed plasma with a duration of 1 ns, 0.527 μm wavelength, ~2500 J, and an adjustable delay time. We measure at least 15 times less backscattered SBS energy with a RPP.

25331 (UCRL-JC–110398) **Physics and modelling of scrape-off layer transport.** Cohen, R.H. (Lawrence Livermore National Lab., CA (United States)); Allen, S.L.; Crotinger, J.A.; Kaiser, T.B.; Milovich, J.L.; Mattor, N.; Nevins, W.M.; Porter, G.D.; Rensink, M.E.; Rognlien, T.D.; Berk, H.L.; Campbell, R.B.; Diamond, P.H.; Rosenbluth, M.Lawrence Livermore National Lab., CA (United States). [1992]. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48 ;FG05-80ET53088 ;FG03-88ER53275 ;AC04-76DP00789 ;AC03-89ER51114. (CONF-9209290–8: 14. international conference on plasma physics and controlled nuclear fusion research, Wurzburg (Germany), 30 Sep - 7 oct 1992). Order Number DE93010510. Source: OSTI; NTIS; INIS; GPO Dep.

We present studies of three schemes for reducing the peak heat flux on divertor plates, divertor biasing, impurity injection ("radiative divertor") and neutral gas injection ("gas target divertor"). We report on theoretical analysis of a likely source of turbulent transport in the SOL and incorporation of the resultant transport coefficients into self-consistent models.

25332 (UCRL-JC–110868) **Steering algorithms for a heavy-ion recirculating accelerator.** Sharp, W.M.; Barnard, J.J.; Yu, S.S. Lawrence Livermore National Lab., CA (United States). 20 May 1992. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-920515–33: 9. international conference on high power particle beams, Washington, DC (United States), 25-29 May 1992). Order Number DE93011947. Source: OSTI; NTIS; INIS; GPO Dep.

For inertial-fusion applications, the beam in proposed recirculating heavy ion accelerators must complete fifty to one hundred laps around lattices that are between two and four killmeters in circumference. Frequent monitoring and correction of the beam-centroid position is essential to avoid unrealistic tolerances on dipole strengths and quadrupole alignment, the beam centroid. Analytic and numerical estimates are made of the beam-centroid displacement due algorithms for both time-dependent and time-independent beam steering are presented. An envelope-code simulation is used to demonstrate their effectiveness.

25333 (UCRL-JC–111381) **Status and plans for ITER.** Glass, A.J. Lawrence Livermore National Lab., CA (United States). Jul 1992. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9204146–6: Fusion Power Associates annual meeting and symposium, Pleasanton, CA (United States), 9 Apr 1992). Order Number DE93011900. Source: OSTI; NTIS; GPO Dep.

In 1987, the United States, Japan, Western Europe, and the Soviet Union combined forces to undertake the design, development, and construction of the world's first power-producing magnetic fusion reactor. This project is called the International Thermonuclear Experimental Reactor (ITER) The overall objective of the ITER project is to demonstrate the scientific and technological feasibility of fusion power for peaceful purposes. In order to accomplish this overall objective, ITER has a three-fold mission. The physics mission is to demonstrate controlled ignition and extended burn of a deuterium-tritium (D-T) plasma with an ultimate goal of steady-state or continuous operation. The technology mission is to demonstrate technologies essential to the development of a demonstration reactor in an integrated system. The testing mission is to perform integrated testing of the high heat flux and nuclear components required for the use of fusion power for practical purposes.

25334 (UCRL-JC–111382) **Opportunities for US industry in the ITER project.** Glass, A.J. Lawrence Livermore National Lab., CA (United States). Jul 1992. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9204146–5: Fusion Power Associates annual meeting and symposium, Pleasanton, CA (United States), 9 Apr 1992). Order Number DE93011901. Source: OSTI; NTIS; GPO Dep.

Elsewhere in this meeting we've discussed the technical objectives of ITER, but one of the immediate objectives of the Engineering Design Activities (EDA) of the ITER project is to prepare

industry in all four participating national groups to bid on the construction of the ITER facility. Accordingly, participation of industry in the EDA is of critical importance to the project. Even if ITER is not constructed, other facilities of comparable scale will be built by one or another of the Parties. Clearly, industrial capabilities are required for a project of this magnitude. Furthermore, to obtain the necessary base of public support and financing for a project of this size requires a broad base of support which cannot be developed without industry's active participation. Of course, ITER is only one step towards the developmentof fusion energy.

25335 (UCRL-JC–111389) **The role of ITER in the US MFE Program Strategy.** Glass, A.J. Lawrence Livermore National Lab., CA (United States). Jul 1992. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-920606–44: American Nuclear Society annual meeting, Boston, MA (United States), 7-12 Jun 1992). Order Number DE93009290. Source: OSTI; NTIS; INIS; GPO Dep.

I want to discuss the role of ITER in the US MFE Program Strategy. I should stress that any opinions I present are purely my own. I'm not speaking ex cathedra, I'm not speaking for the ITER Home Team, and I'm not speaking for the Lawrence Livermore National Laboratory. I'm giving my own personal opinions. In discussing the role of ITER, we have to recognize that ITER plays several roles, and I want to identify how ITER influences MFE program strategy through each of its roles.

25336 (UCRL-JC–113199) **High-field conductor testing at the FENIX facility.** Shen, S.S.; Chaplin, M.R.; Felker, B.; Hassenzahl, W.V.; Kishiyama, K.I.; Parker, J.M. Lawrence Livermore National Lab., CA (United States). 5 Apr 1993. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9303157–1: 8. United States-Japan workshop on high-field superconductors Applied Superconducting Center, Madison, WI (United States), 16-19 Mar 1993). Order Number DE93012318. Source: OSTI; NTIS; INIS; GPO Dep.

The Fusion Engineering International experiments (FENIX) Test Facility, which was commissioned at the end of 1991, is the first facility in the world capable of testing prototype conductors for the International Thermonuclear Experimental Reactor (ITER) superconducting magnets. The FENIX facility provides test conditions that simulate the ITER magnet operating environment; more importantly, it also accommodates specific experiments to determine the operational margins for the prototype conductors. The FENIX facility generates magnetic fields close to 14 T, and transport currents over 40 kA for testing the prototype conductors. This paper describes an experimental program that measures critical currents, current-sharing temperatures, forced-flow properties, and cyclic effects.

25337 (UCRL-LR–105821-92-4) **Inertial confinement fusion: Quarterly report, July–September 1992: Volume 2, Number 4.** Powers, L.; Condouris, R.; Kotowski, M.; Murphy, P.W. (eds.). Lawrence Livermore National Lab., CA (United States). 1992. 62p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE93013303. Source: OSTI; NTIS; GPO Dep.

This issue of the ICF Quarterly contains seven articles that describe recent progress in Lawrence Livermore National Laboratory's ICF program. The Department of Energy recently initiated an effort to design a 1–2 MJ glass laser, the proposed National Ignition Facility (NIF). These articles span various aspects of a program which is aimed at moving forward toward such a facility by continuing to use the Nova laser to gain understanding of NIF-relevant target physics, by developing concepts for an NIF laser driver, and by envisioning a variety of applications for larger ICF facilities. This report discusses research on the following topics: Stimulated Rotational Raman Scattering in Nitrogen; A Maxwell Equation Solver in LASNEX for the Simulation of Moderately Intense Ultrashort Pulse Experiments; Measurements of Radial Heat-Wave Propagation in Laser-Produced Plasmas; Laser-Seeded Modulation Growth on Directly Driven Foils; Stimulated Raman Scattering in Large-Aperture, High-Fluence Frequency-Conversion Crystals; Fission Product Hazard Reduction Using Inertial Fusion Energy; Use of Inertial Confinement Fusion for Nuclear Weapons Effects Simulations.

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25338 (UCRL-ID–112855) **Ghostly events: A review of the namesakes of LLNL nuclear tests of the past few years.** Olsen, C.W. Lawrence Livermore National Lab., CA (United States). Feb 1993. 23p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE93011720. Source: OSTI; NTIS; GPO Dep.

Beginning in Fiscal Year 1986, the LLNL named its tests at the Nevada Test Site for ghost towns and other historical place names in California and Nevada. The first test so named was GOLDSTONE conducted on December 28, 1985. The list of names was used until recently when a new set of names was adopted for use in FY-93 and later. The locations used for event names often had interesting histories of their own. Some sites have virtually disappeared, some are still identifiable ghost towns, some never were towns, and others are relatively recent or still inhabited locations. This paper is a compilation of brief histories of the locations for which tests were named. The towns mostly, but not entirely, date from the mining booms of about 1850 to the early twentieth century. Many of these communities had brief existences; populations ranged from a few hardy souls to several thousand, and amenities ranged from primitive to, in a few rare cases, opulent. The development tended to follow a similar pattern based on size and duration of activity, usually starting with a collection of tents, commonly known as "rag-towns". Generally even the small communities soon had a store, some sort of lodging, and a saloon and gambling hall. As towns grew, if they lasted long enough, they would often acquire a post office, more saloons and stores, better water supplies and transportation, more permanent hotels, sometimes a newspaper, and often a red-light district. This was followed finally by permanent residences and by churches and schools, possibly even a library, and the other trappings of a real community; the ultimate goal was to have a court house. Most sites, of course, went through boom and bust before the full cycle could be realized. These places are the remains of a fascinating and important part of our heritage.

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Refer also to citation(s) 23052, 23761, 24178, 24576, 24799, 24904, 24942

25339 (CNIC–00600) **China nuclear science and technology report (1991). Abstracts.** China Nuclear Information Centre, Beijing, BJ (China). Apr 1992. [78p.] (In Chinese). Order Number DE93626608. Source: OSTI; NTIS (US Sales Only); INIS.

The bibliographies and abstracts of China Nuclear Science and Technology Reports published in 1991 (Report Numbers CNIC-00455 to CNIC-00554) are presented. The items are arranged according to INIS subject categories, which mainly are physics, chemistry, materials, earth sciences, life sciences, isotopes, isotope and radiation applications, engineering and technology, and other aspects of nuclear energy. The numbers on the left corners of the entries are report numbers, and on the right corners the serial numbers. A report number index is annexed.

25340 (CONF-9110444–2) **Automated knowledge acquisition for second generation knowledge base systems: A conceptual analysis and taxonomy.** Williams, K.E.; Kotnour, T. Virginia Polytechnic Inst., Blacksburg, VA (United States). [1991]. 8p. Sponsored by USDOE, Washington, DC (United States); Department of Defense, Washington, DC (United States). DOE Contract FG02-91NP00119. N00014-91-J-1500. From 27. annual meeting of the Institute of Management Sciences; Myrtle Beach, SC (United States); 3-4 Oct 1991. Order Number DE93010317. Source: OSTI; NTIS; GPO Dep.

In this paper, we present a conceptual analysis of knowledge-base development methodologies. The purpose of this research is to help overcome the high cost and lack of efficiency in developing knowledge base representations for artificial intelligence applications. To accomplish this purpose, we analyzed the available methodologies and developed a knowledge-base development methodology taxonomy. We review manual, machine-aided, and machine-learning methodologies. A set of developed characteristics allows description and comparison among the methodologies. We

present the results of this conceptual analysis of methodologies and recommendations for development of more efficient and effective tools.

25341 (CONF-9205327–1) **Addressing problems and implementation issues of self-managing teams.** Van Aken, E.M.; Sink, D.S. Virginia Polytechnic Inst. and State Univ., Blacksburg, VA (United States). Dept. of Industrial and Systems Engineering. [1992]. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-91NP00119. From International industrial engineering conference; Chicago, IL (United States); May 1992. Order Number DE93010316. Source: OSTI; NTIS; GPO Dep.

In response to the significant challenges organizations face today, many managers have put in place continuous improvement efforts to help the organization enhance its competitive position. A key element of continuous improvement efforts is employee involvement; in a recent survey of Fortune 500 organizations on techniques and approaches to improving quality and productivity, respondents listed employee involvement as their number one priority. One of the more complex and mature forms of employee involvement which many organizations have begun to experiment with recently is self-managing teams. A self-managing team is a group of employees, usually eight to fifteen, who is responsible for not only performing work tasks but also managing their work processes. There are common problems and issues associated with implementing self-managing teams, which we will address in this paper. First, however, we will discuss how self-managing teams fit into the broader concept of employee involvement. Then we will describe the results of a case study research project studying how five organizations implemented self-managing teams. The implementation issues we address are the role of the supervisor, the structure of teams, the information requirements of the g necessary, and the compensation (pay) system most often used. Lastly, we will discuss some future trends for self-managing teams.

25342 (CONF-9209334–1) **Information requirements of self-managing teams.** Van Aken, E.M. Virginia Polytechnic Inst. and State Univ., Blacksburg, VA (United States). Dept. of Industrial and Systems Engineering. [1992]. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-91NP00119. From International conference on self-managing teams; Dallas, TX (United States); Sep - oct 1992. Order Number DE93010319. Source: OSTI; NTIS; GPO Dep.

In response to the significant challenges organizations face today, many managers have put in place continuous improvement efforts to help the organization on enhance its competitive position. A key element of continuous improvement efforts is employee involvement, and one of the most complex, mature, and effective forms of employee involvement is self-managing teams. A self-managing team is a group of employees, usually eight to fifteen, which is responsible for planning, implementing, controlling, and improving work processes. There are many characteristics of self-managing teams which are discussed frequently in the literature and are common topics of seminars and workshops on SMTs, including the role of the first-line supervisor, the structure of teams, the training necessary, and the pay system for SMTs. However, one area which has not been as widely researched is the role of information - what types of information do self-managing teams need? This paper addresses this question. Results from a multiple case study research project focusing on the information requirements of SMTs are presented. Specifically, seven types of information SMTs need are identified, as well as general characteristics of the information system. By information system, I mean very broadly, the system (both formal and informal) which provides information of any kind to a self-managing team. The results of this research can be thought of as "design features" for an information system to support SMTs. Practicing managers can use these design features in two ways: they can design them into beginning SMT efforts; or, for SMTs already established, managers can compare them to the existing information system and adjust accordingly.

25343 (DOE/OR/00033–T528) **Training implications of selected DOE orders resource guide.** Oak Ridge Inst. for Science and Education, TN (United States). Nov 1992. 478p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-76OR00033. Order Number DE93013318. Source: OSTI; NTIS; GPO Dep.

The Training Resources and Data Exchange (TRADE) is a network that encourages and facilitates the exchange of ideas, techniques, and resources for improving training and development and serves as a forum for the discussion of issues of interest to the US Department of Energy (DOE) community. TRADE encompasses a wide range of activities which include: conferences, workshops, and meetings; special interest groups; resource guides, curriculum development, and good practices publications; training resources directories for the DOE system; and electronic bulletin board services. This resource guide, which updates one published in January 1988, is intended to be used by DOE and DOE contractor personnel in identifying and responding to training requirements established in DOE Orders. The requirements addressed in this guide relate primarily to environment, safety, and health issues; therefore, the guide does not address every DOE Order. The DOE Orders and other guidance documents addressed in this guide are listed in the Table of Contents. Several orders were in draft at the time of publication and are indicated as draft. This guide also contains training implications of several DOE manuals.

25344 (ES/ER/TM–61) **Environmental Restoration Program pollution prevention performance measures for FY 1993 and 1994 remedial investigations: Management training manual.** Oak Ridge National Lab., TN (United States); Weston (Roy F.), Inc., Oak Ridge, TN (United States). Mar 1993. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400 ;AC05-76OR00001. Order Number DE93010833. Source: OSTI; NTIS; INIS; GPO Dep.

This computer-based program is designed to help waste generators in the Environmental Restoration (ER) Program prevent pollution at the DOE Oak Ridge Field Office (DOE-OR) facilities in Oak Ridge, Paducah, and Portsmouth. The Numerical Scoring System (NSS) is an interactive system designed to maintain data on ER Program pollution prevention efforts and to measure the success of these efforts through the ER Program life cycle.

25345 (EUR–14755) **Annual Report 1991. Institute for systems engineering and informatics.** Commission of the European Communities, Luxembourg (Luxembourg). 1992. [128p.] Source: OSTI; NTIS (US Sales Only); INIS.

The report presents the achievements of the Institute for Systems Engineering and Informatics (ISEI) of the Joint Research Centre (JRC) of the Commission of the European Communities (CEC) for 1991. The JRC is a European scientific and technical research centre established by the member states of the CEC. Its four sites in Belgium (Geel), Germany (Karlsruhe), the Netherland (Petten) and Italy (Ispra) house 8 institutes, each with its own focus of expertise. ISEI, based at Ispra, was created in 1990 by the merger of the Institute for Systems Engineering (ISE) and the Centre for Information Technologies and Electronics (CITE). The main areas of activity of the Institute are: - Industrial and Environmental Risk, - Nuclear Safeguards, -Fusion Reactor Systems Integration and Safety, - Solar Energy Systems and Energy Management, - Advanced Computing, - Informatic services.

25346 (IAEA-CPE–92/01) **The Agency's Technical Co-operation programme in Chile, 1981-1991. Country programme evaluation.** International Atomic Energy Agency, Vienna (Austria). Evaluation Section. 14 Apr 1992. [127p.] Order Number DE93624728. Source: OSTI; NTIS (US Sales Only); INIS.

Agency support for nuclear activities in Chile dates back to the early 1960s. During the last ten years, this support has considerably expanded. In 1981-1991, 62 Agency projects with allotments amounting to over $7 million were completed or are under implementation. Chile has received 360 man-months of expert services, $3.4 million worth of equipment, and 105 fellowships for some 390 man-months of training. In addition, 262 Chileans attended 219 Agency regional and interregional training courses, and Chilean institutions were awarded 40 research contracts worth over $325,000. This evaluation covers ten years of Agency technical co-operation with Chile, during which 35 projects were completed and 27 are still being implemented. Eight major sectors received assistance: general atomic energy development; nuclear physics; nuclear raw

materials; nuclear engineering and technology; nuclear techniques in agriculture; nuclear medicine; hydrology; and nuclear safety. The evaluation concluded that, overall, the Agency's technical co-operation activities have, in keeping with the national priorities concerning peaceful nuclear applications, contributed substantially to the establishment of Chile's nuclear scientific and technical infrastructure, and played a major role in Chile's efforts to introduce nuclear applications in a number of sectors of the economy, with many benefits for broader national development objectives. Another strength of the Agency's programme with Chile is the high level of commitment and dedication that was noted in the great majority of recipient institutions, and in particular at the Comision Chilena de Energia Nuclear, CChEN. Mention should also be made of the fact that bureaucracy appears to be less severe than in some other developing countries, and that constraints that frequently affect other countries, such as insufficient counterpart commitment and lack of continuity of personnel, are considerably less acute.

25347 (IAEA-CPS–92/01) **The Agency's Technical Co-operation programme with Costa Rica, 1982-1992. Country programme summaries.** International Atomic Energy Agency, Vienna (Austria). Evaluation Section. 2 Apr 1992. [39p.] Order Number DE93624729. Source: OSTI; NTIS (US Sales Only); INIS.

The country programme summary reported here is one in the series of such studies being undertaken of the Agency's TC programme with Member States. With over $2.8 million of Agency support received, Costa Rica ranks 49th among all recipients of technical assistance in the period 1958-1991. Over half of the assistance during the past ten years has been provided in the form of equipment (52%), followed by expert services (37%) and training (11%). Sixty-two per cent of the resources were made available through the Technical Assistance and Co-operation Fund, while 37% of the resources were provided by UNDP. The rest was made available through extrabudgetary contributions (5%) and through in-kind assistance (1%). With regard to project disbursement by sector, the largest areas have been nuclear raw materials (36%), nuclear physics and chemistry (24%) and agriculture (20%). Smaller shares have gone to hydrology (11%) and nuclear medicine (8%).

25348 (IAEA-CPS–92/02) **The Agency's Technical Co-operation programme with Cuba, 1982-1992. Country programme summaries.** International Atomic Energy Agency, Vienna (Austria). Evaluation Section. 2 Apr 1992. [43p.] Order Number DE93624730. Source: OSTI; NTIS (US Sales Only); INIS.

The country programme summary reported here is one in the series of such studies being undertaken of the Agency's TC programme with Member States. With almost $8.2 million of Agency support received, Cuba ranks 19th among all recipients of technical assistance in the period 1958 - 1991, whereby it ranked as high as 3rd in 1982 and 4th in 1984. Over three quarters of the assistance during the past ten years has been provided in the form of equipment (81%), followed by expert services (10%) and training (9%). Seventy-one per cent of the resources were made available through the Technical Assistance and Co-operation Fund, while 28% of the resources were provided by UNDP. The remaining 1% was made available through extrabudgetary and in-kind contributions. With regard to project disbursements by sector, the largest areas have been general atomic energy development (36%), agriculture (20%), nuclear physics and chemistry (10%) and nuclear safety (10%). Industry and hydrology, nuclear engineering and technology, and nuclear medicine have each received less than ten per cent of the assistance provided.

25349 (IAEA-CPS–92/03) **The Agency's Technical Co-operation programme with Peru, 1982-1992. Country programme summaries.** International Atomic Energy Agency, Vienna (Austria). Evaluation Section. 2 Apr 1992. [54p.] Order Number DE93624731. Source: OSTI; NTIS (US Sales Only); INIS.

The country programme summary reported here is one in the series of such studies being undertaken of the Agency's TC programme with Member States. With over $12.6 million of Agency support received, Peru ranks 4th among all recipients of technical assistance in the period 1958 - 1991, whereby it ranked as high as 2nd in each of the four years 1982 through 1985. More than half of the assistance during the past ten years has been provided in the form of equipment (59%), followed by expert services (29%) and training (12%). Forty-five per cent of the resources were provided by the Technical Assistance and Co-operation Fund, while 29% of the resources were made available through extrabudgetary contributions, and 21% by UNDP. The remaining 5% were provided in kind. With regard to project disbursement by sector, the largest areas have been agriculture (27%), general atomic energy development (17%), nuclear raw materials (14%), nuclear medicine (12%) and industry and hydrology (11%). Nuclear safety, nuclear engineering and technology, and nuclear physics and chemistry have each received less than ten per cent of the assistance provided.

25350 (IAEA-CPS–92/04) **The Agency's Technical Co-operation programme with Uruguay, 1982-1992. Country programme summaries.** International Atomic Energy Agency, Vienna (Austria). Evaluation Section. 2 Apr 1992. [45p.] Order Number DE93624732. Source: OSTI; NTIS (US Sales Only); INIS.

The country programme summary reported here is one in the series of such studies being undertaken of the Agency's TC programme with Member States. With over $4.2 million of Agency support received, Uruguay ranks 37th among all recipients of technical assistance in the period 1958 - 1991. More than half of the assistance during the past ten years has been provided in the form of equipment (67%), followed by expert services (19%) and training (14%). Seventy-three per cent of the resources were provided through the Technical Assistance and Co-operation Fund, while 24% were made available through extrabudgetary contributions. The remaining 3% were provided through assistance in kind, with only an insignificant contribution by UNDP. With regard to project disbursement by sector, the largest areas have been nuclear medicine (35%), agriculture (23%), general atomic energy development (17%), followed by nuclear physics and chemistry (11%) and industry and hydrology (7%).

25351 (IAEA-CPS–92/05) **The Agency's Technical Co-operation programme with Guatemala, 1982-1992. Country programme summaries.** International Atomic Energy Agency, Vienna (Austria). Evaluation Section. 7 Apr 1992. [40p.] Order Number DE93624733. Source: OSTI; NTIS (US Sales Only); INIS.

The country programme summary reported here is one in the series of such studies being undertaken of the Agency's TC programme with Member States. With over $3 million of Agency support received, Guatemala ranks 46th among all recipients of technical assistance in the period 1958 - 1991. Almost three quarters of the assistance during the past ten years has been provided in the form of equipment (72%), followed by training (15%) and expert services (13%). Seventy-eight per cent of the resources were provided by the Technical Assistance and Co-operation Fund, the rest was made available through extrabudgetary contributions (21%) and assistance in kind (1%). With regard to project disbursement by sector, the largest areas have been nuclear physics and chemistry (37%), agriculture (28%), nuclear medicine (16%) and hydrology (8%). The remaining 11% were shared by general atomic energy development, nuclear raw materials, nuclear engineering and technology, and nuclear safety.

25352 (IAEA-CPS–92/06) **The Agency's Technical Co-operation programme with the United Republic of Tanzania, 1982-1992. Country programme summaries.** International Atomic Energy Agency, Vienna (Austria). Evaluation Section. 19 Jun 1992. [35p.] Order Number DE93624734. Source: OSTI; NTIS (US Sales Only); INIS.

The country programme summary reported here is one in the series of such studies being undertaken of the Agency's TC programme with Member States. With over $ 3.4 million of Agency support received, the United Republic of Tanzania ranks 44th among all recipients of technical assistance in the period 1958 - 1991. Almost half of the assistance during the past ten years has been provided in the form of equipment (49%), followed by training through fellowships and scientific visits (29%) and expert services (22%). Ninety-two per cent of the resources were provided by the Technical Assistance and Co-operation Fund, the rest was made available through assistance in kind (5%) and through extrabudgetary contributions (3%). With regard to project disbursement by sector, by far the largest share has gone to agriculture (48%), followed by nuclear physics (20%), nuclear safety (17%) and nuclear medicine (11%).

25353 (IAEA-CPS–92/07) **The Agency's Technical Co-operation programme with Senegal, 1982-1992. Country programme summaries.** International Atomic Energy Agency, Vienna (Austria). Evaluation Section. 22 Jun 1992. [36p.] Order Number DE93624735. Source: OSTI; NTIS (US Sales Only); INIS.

The country programme summary reported here is one in the series of such studies being undertaken of the Agency's TC programme with Member States. With $2.2 million of Agency support received, Senegal ranks 56th among all recipients of technical assistance in the period 1958 - 1991. More than one-third of the assistance during the past ten years has been provided in the form of equipment (67%), followed by expert services (21%) and training (12%). Eighty per cent of the resources were provided by the Technical Assistance and Co-operation Fund, while 16% were made available by UNDP and about 2% each through extrabudgetary contributions and assistance in kind. With regard to project disbursement by sector, by far the largest area has been agriculture (43%). Smaller shares have gone to general atomic energy development (15%), nuclear physics and chemistry (13%), nuclear medicine and hydrology (11% each), and nuclear safety (7%).

25354 (IAEA-CPS–92/08) **The Agency's Technical Co-operation programme with Ghana, 1982-1992. Country programme summaries.** International Atomic Energy Agency, Vienna (Austria). Evaluation Section. 24 Jun 1992. [42p.] Order Number DE93624736. Source: OSTI; NTIS (US Sales Only); INIS.

The country programme summary reported here is one in the series of such studies being undertaken of the Agency's TC programme with Member States. With over $6.5 million of Agency support received, Ghana ranks 29th among all recipients of technical assistance in the period 1958 - 1991. More than half of the assistance during the past ten years has been provided in the form of equipment (53%), followed by training through fellowships and scientific visits (34%) and expert services (13%). Seventy-four per cent of the resources were provided by the Technical Assistance and Co-operation Fund, 13% through assistance in kind, 11% through extrabudgetary contributions, and 2% by UNDP. It should be noted that the share for extrabudgetary contributions includes an amount of $250,000 made available by the Ghanaian Government for the purchase of equipment by the Agency under a funds-in-trust arrangement. With regard to project disbursement by sector, the largest share has gone to agriculture (36%), followed by nuclear physics and chemistry (21%), nuclear medicine (16%), industry and hydrology (14%) and nuclear engineering and technology (9%).

25355 (IAEA-CPS–92/09) **The Agency's Technical Co-operation programme with Egypt, 1982-1992. Country programme summaries.** International Atomic Energy Agency, Vienna (Austria). Evaluation Section. 26 Jun 1992. [68p.] Order Number DE93624737. Source: OSTI; NTIS (US Sales Only); INIS.

The country programme summary reported here is one in the series of such studies being undertaken of the Agency's TC programme with Member States. With over $22.2 million of Agency support received, Egypt ranks first among all recipients of technical assistance, not only for the period 1958 - 1991, but also held this rank in each of the five years 1982 through 1986 and in 1988. More than half of this assistance has been provided in the form of equipment (57%), followed by expert services (19%), training (17%) and sub-contracts (7%). With 42% and 43%, respectively, the Technical Assistance and Co-operation Fund and extrabudgetary contributions hold almost equal shares in the total resources available, while in-kind assistance accounts for 9% and UNDP for 6% of the resources. With regard to project disbursement during the past ten years, by sector, the two largest areas have been nuclear safety (34%) and agriculture (33%), followed by nuclear engineering and technology (11%). Smaller shares - from 4% to 7% each– have gone to industry and hydrology, nuclear medicine, nuclear physics and chemistry, and general atomic energy development.

25356 (IAEA-CPS–92/10) **The Agency's Technical Co-operation programme with Nigeria, 1982-1992. Country programme summaries.** International Atomic Energy Agency, Vienna (Austria). Evaluation Section. 3 Sep 1992. [48p.] Order Number DE93624738. Source: OSTI; NTIS (US Sales Only); INIS.

The country programme summary reported here is one in the series of such studies being undertaken of the Agency's TC programme with Member States. With over $9.3 million of Agency support received, Nigeria ranks 14th among all recipients of technical assistance in the period 1958 through 1991. During the past ten years, 44% of this assistance has been provided in the form of equipment, followed by training (27%), expert services (26%) and sub-contracts (3%). With 45% and 44%, respectively, the Technical Assistance and Co-operation Fund and extrabudgetary contributions hold almost equal shares in the total resources made available, while in-kind assistance accounts for 9% and UNDP for 2% of the resources. With regard to project disbursement during the past ten years, by sector, by far the largest area has been agriculture (70%), with significantly smaller shares going to nuclear physics and chemistry (11%), nuclear medicine (8%) and nuclear safety (7%).

25357 (IAEA-CPS–92/11) **The Agency's Technical Co-operation programme with Sudan, 1982-1992. Country programme summaries.** International Atomic Energy Agency, Vienna (Austria). Evaluation Section. 8 Sep 1992. [42p.] Order Number DE93624739. Source: OSTI; NTIS (US Sales Only); INIS.

The country programme summary reported here is one in the series of such studies being undertaken of the Agency's TC programme with Member States. With over $5.7 million of Agency support received, Sudan ranks 31st among all recipients of technical assistance in the period 1958 through 1991. Over the past ten years, almost equal shares of this assistance were provided in the form of equipment (46%) and training (42%), and only a small percentage was provided in the form of expert services (12%). The best part of the resources was made available through the Technical Assistance and Co-operation Fund (77%), while in-kind and extrabudgetary contributions account for 13% and 10% of the resources, respectively. With regard to project disbursement during the past ten years, by sector, the two largest areas have been general atomic energy development (37%) and agriculture (21%), followed by nuclear medicine (14%). Smaller shares (6% each) have gone to nuclear physics and chemistry, nuclear engineering and technology, hydrology, and nuclear safety.

25358 (IAEA-CPS–92/12) **The Agency's Technical Co-operation programme with Zaire, 1982-1992. Country programme summaries.** International Atomic Energy Agency, Vienna (Austria). Evaluation Section. 14 Sep 1992. [39p.] Order Number DE93624740. Source: OSTI; NTIS (US Sales Only); INIS.

The country programme summary reported here is one in the series of such studies being undertaken of the Agency's TC programme with Member States. With $3.9 million of Agency support received, Zaire ranks 38th among all recipients of technical assistance in the period 1958 through 1991. More than half of the assistance during the past ten years has been provided in the form of equipment (60%), followed by training (24%) and expert services (16%). With a share of 76%, the Technical Assistance and Co-operation Fund has provided more than three quarters of the total resources available, while only small shares were made available through UNDP (11%), extrabudgetary contributions (4%) and assistance in kind (9%). With regard to project disbursements during the past ten years, by sector, the largest area has been general atomic energy development (26%), followed by agriculture (18%), nuclear safety (18%), nuclear techniques in industry and hydrology (13%), and nuclear physics and chemistry (11%).

25359 (IAEA-CPS–92/13) **The Agency's Technical Co-operation programme with Zambia, 1982-1992. Country programme summaries.** International Atomic Energy Agency, Vienna (Austria). Evaluation Section. 16 Sep 1992. [39p.] Order Number DE93624741. Source: OSTI; NTIS (US Sales Only); INIS.

The country programme summary reported here is one in the series of such studies being undertaken of the Agency's TC programme with Member States. With $5.5 million of Agency support received, Zambia ranks 33rd among all recipients of technical assistance in the period 1958 through 1991. More than half of the assistance during the past ten years has been provided in the form of equipment (61%), followed by expert services (25%) and training (14%). Almost all of the resources made available came from the Technical Assistance and Co-operation Fund (93%), with only very

small shares provided through extrabudgetary contributions (4%) and assistance in kind (3%). With regard to project disbursements during the past ten years, by sector, the largest areas have been agriculture (33%) and general atomic energy development (23%), followed by industry and hydrology (19%), nuclear raw materials (13%) and nuclear safety (6%).

25360 (IAEA-CPS–92/14) **The Agency's Technical Co-operation programme with Algeria, 1982-1992. Country programme summaries.** International Atomic Energy Agency, Vienna (Austria). Evaluation Section. 10 Nov 1992. [40p.] Order Number DE93624742. Source: OSTI; NTIS (US Sales Only); INIS.

The country programme summary reported here is one in the series of such studies being undertaken of the Agency's TC programme with Member States. With $3.6 million of Agency support received, Algeria ranks 41st among all recipients of technical assistance in the period 1958-1991. Seventy per cent of the assistance received during the past ten years has been in the form of equipment, followed by expert services (17%) and training (13%). Almost all of the resources were provided by the Technical Assistance and Co-operation Fund (97%), the remaining 3% were made available through assistance in kind. With regard to project disbursement by sector, the three major areas have been nuclear physics and chemistry (28%), agriculture (27%) and nuclear medicine (20%).

25361 (IAEA-CPS–92/15) **The Agency's Technical Co-operation programme with Kenya, 1982-1992. Country programme summaries.** International Atomic Energy Agency, Vienna (Austria). Evaluation Section. 10 Nov 1992. [37p.] Order Number DE93624743. Source: OSTI; NTIS (US Sales Only); INIS.

The country programme summary reported here is one in the series of such studies being undertaken of the Agency's TC programme with Member States. With almost $3.9 million of Agency support received, Kenya ranks 39th among all recipients of technical assistance during the period 1958-1991. Almost half of the assistance during the past ten years has been provided in the form of the equipment (44%), followed by training (33%) and expert services (23%). Two-thirds of the funds available were provided by the Technical Assistance and Co-operation Fund (66%), while extrabudgetary contributions accounted for 18%, in-kind contributions for 14%, and UNDP for 2% of the resources. With regard to project disbursements during the past ten years, by sector, the four major areas have been general atomic energy development (30%), agriculture (22%), nuclear medicine and nuclear safety (13% each).

25362 (IAEA-CPS–92/16) **The Agency's Technical Co-operation programme with Madagascar, 1982-1992. Country programme summaries.** International Atomic Energy Agency, Vienna (Austria). Evaluation Section. 12 Nov 1992. [32p.] Order Number DE93624744. Source: OSTI; NTIS (US Sales Only); INIS.

The country programme summary reported here is one in the series of such studies being undertaken of the Agency's TC programme with Member States. With over $3.5 million of Agency support received, Madagascar ranks 42nd among all recipients of technical assistance in the period 1958 through 1991. More than half of the assistance during the past ten years has been provided in the form of equipment (55%), followed by expert services (32%) and training (13%). With a share of 69%, the Technical Assistance and Co-operation Fund has provided more than two-thirds of the total resources available, while 29% were made available through UNDP and 2% through assistance in kind. Extrabudgetary contributions accounted for less than one per cent. With regard to project disbursements during the past ten years, by sector, by far the largest area has been nuclear raw materials (66%), followed by nuclear physics and chemistry (18%). Only small shares have gone to nuclear safety (7%), agriculture (5%) and nuclear engineering and technology (4%).

25363 (IAEA-CPS–92/17) **The Agency's Technical Co-operation programme with Mali, 1982-1992. Country programme summaries.** International Atomic Energy Agency, Vienna (Austria). Evaluation Section. 12 Nov 1992. [34p.] Order Number DE93624745. Source: OSTI; NTIS (US Sales Only); INIS.

The country programme summary reported here is one in the series of such studies being undertaken of the Agency's TC programme with Member States. With over $2.7 million of Agency support received, Mali ranks 51st among all recipients of technical assistance in the period 1958 through 1991. More than half of the assistance during the past ten years has been provided in the form of equipment (58%), followed by expert services (27%) and training (15%). With a share of 93%, the Technical Assistance and Co-operation Fund has provided the best part of the resources, while only very small shares were made available through extrabudgetary contributions and assistance in kind (5% and 2%, respectively). With regard to project disbursements during the past ten years, by sector, the four major areas have been hydrology (31%), nuclear medicine (24%), agriculture (21%) and nuclear raw materials (16%).

25364 (IAEA-CPS–92/18) **The Agency's Technical Co-operation programme with Cameroon, 1982-1992. Country programme summaries.** International Atomic Energy Agency, Vienna (Austria). Evaluation Section. 18 Nov 1992. [33p.] Order Number DE93624746. Source: OSTI; NTIS (US Sales Only); INIS.

The country programme summary reported here is one in the series of such studies being undertaken of the Agency's TC programme with Member States. With $1.3 million of Agency support received, Cameroon ranks 68th among all recipients of technical assistance in the period 1958 through 1991. More than half of the assistance received during the past ten years has been provided in the form of equipment (61%), followed by expert services (24%) and training (15%). The best part of the resources were provided by the Technical Assistance and Co-operation Fund (90%); the remaining ten per cent were made available through extrabudgetary contributions (8%) and assistance in kind (2%). With regard to project disbursements by sector, the four major areas have been nuclear physics and chemistry (38%), agriculture (23%), nuclear medicine (14%) and hydrology (13%).

25365 (IAEA-CPS–92/19) **The Agency's Technical Co-operation programme with Cote d'Ivoire, 1982-1992. Country programme summaries.** International Atomic Energy Agency, Vienna (Austria). Evaluation Section. 18 Nov 1992. [31p.] Order Number DE93624747. Source: OSTI; NTIS (US Sales Only); INIS.

The country programme summary reported here is one in the series of such studies being undertaken of the Agency's TC programme with Member States. With over $1.7 million of Agency support received, Cote d'Ivoire ranks 60th among all recipients of technical assistance in the period 1958 through 1991. Over half of the assistance received during the past ten years has been in the form of equipment (59%), complemented by expert services (26%) and training (15%). The best part of the resources was provided by the Technical Assistance and Co-operation Fund (91%), the remainder was made available through extrabudgetary contributions (7%) and through assistance in kind (2%). During the past ten years, project activities - and disbursements - have concentrated exclusively on three major areas: agriculture (59%), general atomic energy development (30%) and nuclear safety (11%).

25366 (IAEA-CPS–92/20) **The Agency's Technical Co-operation programme with Ethiopia, 1982-1992. Country programme summaries.** International Atomic Energy Agency, Vienna (Austria). Evaluation Section. 18 Nov 1992. [33p.] Order Number DE93624748. Source: OSTI; NTIS (US Sales Only); INIS.

The country programme summary reported here is one in the series of such studies being undertaken of the Agency's TC programme with Member States. With some $2.5 million of Agency support received, Ethiopia ranks 54th among all recipients of technical assistance in the period 1958 through 1991. More than half of the assistance received during the past ten years has been provided in the form of equipment (55%), complemented by expert services (16%) and training (29%). The best part of the resources was provided by the Technical Assistance and Co-operation Fund (88%), the remainder was made available through assistance in kind (6%), UNDP and extrabudgetary contributions (3% each). During the past ten years, project disbursements went to four major areas: agriculture (45%), nuclear medicine (35%), nuclear safety (14%) and nuclear engineering and technology (6%).

25367 (IAEA-CPS–92/21) **The Agency's Technical Co-operation programme with Niger, 1982-1992. Country**

programme summaries. International Atomic Energy Agency, Vienna (Austria). Evaluation Section. 20 Nov 1992. [33p.] Order Number DE93624749. Source: OSTI; NTIS (US Sales Only); INIS.

The country programme summary reported here is one in the series of such studies being undertaken of the Agency's TC programme with Member States. With some $1.5 million of Agency support received, Niger ranks 65th among all recipients of technical assistance in the period 1958 through 1991. About two-thirds of the assistance received during the past ten years has been provided in the form of equipment (62%), complemented by expert services (26%) and training (12%). Almost the entire resources utilized were provided by the Technical Assistance and Co-operation Fund (96%), with only a small share made available through assistance in kind (4%). With regard to project disbursements by sector, the four major areas have been agriculture (34%), general atomic energy development (31%), hydrology (18%) and nuclear safety (12%).

25368 (IAEA-CPS–92/22) **The Agency's Technical Co-operation programme with Sierra Leone, 1982-1992. Country programme summaries.** International Atomic Energy Agency, Vienna (Austria). Evaluation Section. 20 Nov 1992. [31p.] Order Number DE93624750. Source: OSTI; NTIS (US Sales Only); INIS.

The country programme summary reported here is one in the series of such studies being undertaken of the Agency's TC programme with Member States. With over $1.1 million of Agency support received, Sierra Leone ranks 70th among all recipients of technical assistance in the period 1958 through 1991. Almost equal shares of the assistance during the past ten years have been provided in the form of equipment (40%) and expert services (37%), while the share of the training component was 23%. The best part of the resources was provided by the Technical Assistance and Co-operation Fund (96%), the remaining 4% was made available through assistance in kind. During the past ten years, project activities - and disbursements - have concentrated exclusively on three major areas: nuclear medicine (52%), general atomic energy development (25%) and agriculture (23%).

25369 (IAEA-CPS–92/23) **The Agency's Technical Co-operation programme with Uganda, 1982-1992. Country programme summaries.** International Atomic Energy Agency, Vienna (Austria). Evaluation Section. 20 Nov 1992. [33p.] Order Number DE93624751. Source: OSTI; NTIS (US Sales Only); INIS.

The country programme summary reported here is one in the series of such studies being undertaken of the Agency's TC programme with Member States. With $1.6 million of Agency support received, Uganda ranks 61st among all recipients of technical assistance in the period 1958 through 1991. Almost half of the assistance received during the past ten years has been provided in the form of equipment (47%), complemented by a strong training component (37%), while expert services have received only a relatively small share (16%). Ninety-eight per cent of the resources were provided by the Technical Assistance and Co-operation Fund, the remaining two per cent were made available through assistance in kind. During the past ten years, project activities - and disbursements - have concentrated exclusively on three major areas: agriculture (64%), nuclear medicine (24%) and nuclear safety (12%).

25370 (IAEA-CPS–92/24) **The Agency's Technical Co-operation programme with Mexico, 1982-1992. Country programme summaries.** International Atomic Energy Agency, Vienna (Austria). Evaluation Section. 2 Dec 1992. [65p.] Order Number DE93624752. Source: OSTI; NTIS (US Sales Only); INIS.

The country programme summary reported here is one in the series of such studies being undertaken of the Agency's TC programme with Member States. With almost $7.7 million of Agency support received, Mexico ranks 21st among all recipients of technical assistance during the period 1958 through 1991. The largest share of the assistance received during the past ten years has been in the form of expert services (36%), followed by equipment and training (27% each) and sub-contracts (10%). Almost two-thirds of the funds available were provided by the Technical Assistance and Co-operation Fund (65%), the rest was made available through extrabudgetary contributions (21%) and assistance in kind (14%). With regard to project disbursements during the past ten years, by sector the five major areas have been nuclear safety (34%), nuclear engineering and technology (27%), agriculture (17%), nuclear physics and chemistry (9%), and nuclear techniques in industry and hydrology (9%).

25371 (IAEA-CPS–92/25) **The Agency's Technical Co-operation programme with Brazil, 1982-1992. Country programme summaries.** International Atomic Energy Agency, Vienna (Austria). Evaluation Section. 10 Dec 1992. [69p.] Order Number DE93624753. Source: OSTI; NTIS (US Sales Only); INIS.

The country programme summary reported here is one in the series of such studies being undertaken of the Agency's TC programme with Member States. With over $17 million of Agency support received, Brazil ranks 2nd among all recipients of technical assistance during the period 1958 through 1991. Over half of the assistance received during the past ten years has been provided in the form of equipment (51%), complemented by expert services (34%) and training (15%). Almost two-thirds of the funds were made available through the Technical Assistance and Co-operation Fund (63%), the rest was provided through extrabudgetary contributions (30%), assistance in kind (4%) and UNDP (3%). With regard to total disbursements - by sector - under those projects that were operational during the period 1982 through November 1992, the three major areas have been: general atomic energy development (47%), nuclear safety (22%) and agriculture (13%). During the same period, the country has provided experts and training course lectures for a total of 405 assignments, and has hosted 178 fellowships and scientific visits as well as 46 regional and interregional training events with a total of 603 participants.

25372 (IAEA-CPS–92/26) **The Agency's Technical Co-operation programme with Argentina, 1982-1992. Country programme summaries.** International Atomic Energy Agency, Vienna (Austria). Evaluation Section. 18 Dec 1992. [50p.] Order Number DE93624754. Source: OSTI; NTIS (US Sales Only); INIS.

The country programme summary reported here is one in the series of such studies being undertaken of the Agency's TC programme with Member States. With over $7.5 million of Agency support received, Argentina ranks 22nd among all recipients of technical assistance during the period 1958 through 1991. Forty-six per cent of the assistance received during the past ten years has been provided in the form of equipment, complemented by expert services (40%) and training (14%). The largest share of the resources was made available by UNDP (87%), and only small shares were provided through the TACF (12%) and assistance in kind (less than 1%). With regard to total disbursements - by sector - under those projects that were operational during the period 1982 through mid-December 1992, by far the largest area has been nuclear engineering and technology (91%), while only very small shares went to nuclear safety (4%), industry and hydrology (3%) and agriculture (2%). During the same period, the country has provided experts and training course lectures for a total of 601 assignments, and has hosted 153 fellowships and scientific visits as well as 42 regional and interregional training courses with a total of 568 participants.

25373 (IAEA-SE–92/01) **A special evaluation: The ARCAL programme.** International Atomic Energy Agency, Vienna (Austria). Evaluation Section. 9 Nov 1992. [169p.] Order Number DE93624755. Source: OSTI; NTIS (US Sales Only); INIS.

The Regional Co-operative Arrangements for the Promotion of Nuclear Science and Technology in Latin America, ARCAL, came into being in 1983. At a meeting held in Vienna in September 1984, ten Latin American countries agreed to participate in the programme, the Guidelines setting up the structure of the programme were approved and nine areas of development were identified to initiate project activities. The programme, which is now in its second phase and in its ninth year of implementation, has 17 Member States and includes fifteen projects. Total disbursements under the ARCAL programme during the period 1983 - 1991 amounted to $8.5 million, including $5.4 million from the Technical Assistance and Co-operation Fund (TACF), $2.2 million from extrabudgetary sources, and some $0.9 million in the form of in-kind contributions. As of September 1992, equipment totaling $3.5 million, 385 man-months of expert services, and 108 fellowships for approximately 150 man-months of training had been provided to ARCAL Member

States within the context of fifteen ARCAL projects. In addition, 1844 Latin Americans were trained in 194 ARCAL training courses. The evaluation concluded that, as a result of the ARCAL programme, there is now better knowledge in participating countries about nuclear techniques and technology, as well as greater awareness at most levels of the importance of radiological safety and of the need to implement radiation protection measures, both a the national and at the regional level. The programme has contributed to developing and/or improving capabilities in the region in various applications of nuclear techniques through training activities. The programme has further allowed the establishment of regional collaborative links, particularly between countries with similar interests, in important fields of application, such as agriculture and nuclear medicine. Figs and tabs.

25374 (IAEA-SE–92/02) **Manpower development in Africa and the regional manpower development project RAF/0/003. Special evaluation.** International Atomic Energy Agency, Vienna (Austria). Evaluation Section. 16 Nov 1992. [95p.] Project RAF/0/003. Order Number DE93624756. Source: OSTI; NTIS (US Sales Only); INIS.

At the start of the Agency's technical co-operation activities in 1958, many of its developing Member States were just embarking on nuclear activities. To make basic nuclear training available for these countries became the first concern of the Agency and initially fellowships constituted more than 80% of the assistance provided. During the 1960s, fellowships represented more than 50% of the assistance provided to individual Member States. As counterpart institutions slowly build up small cadres of qualified staff, the share of training in the Agency's programme of technical co-operation became less dominant and, by 1986, only 22% of the funds were devoted to fellowships. In the Africa region, where the share of fellowship training provided to individual Member States had dropped even below the 20% mark, and where the participation in group training events was the lowest of any region, this was having serious consequences on manpower development. At least some opportunities exist in about 60% of the countries in the region for training in selected areas of nuclear science and technology, but only 20% of the countries provide training up to the MSc/PhD level. The number of trainees in nuclear science and technology graduating each year from national institutions is very small and cannot be considered adequate to satisfy existing manpower needs of the country concerned and of the region as a whole. Very few - if any - opportunities for nuclear training abroad are available for candidates from the region other than those funded by the Agency. There is very little awareness at the national level as to the actual training needs in the nuclear field in most countries of the region, underlining the importance of the role of the Agency, not only as a provider of training, but also as an adviser on assessing training needs at the time national development plans are established.

25375 (IAEA-TC-PM–004) **Country programme review. Mongolia.** Dolnicar, J.; Kamel, R.; Perera, O.; Tauchid, M. International Atomic Energy Agency, Vienna (Austria). Div. of Technical Co-operation Programmes. Aug 1992. [35p.] Project INT/0/053. Order Number DE93626610. Source: OSTI; NTIS (US Sales Only); INIS.

This document reviews the current nuclear program in Mongolia, identifying the peaceful uses of nuclear technology in the country and possible future technical co-operation activities. Separate brief sections deal with food and agriculture; mineral resources; nuclear chemistry, nuclear physics and instrumentation; human health; radiation protection; water resources and nuclear energy. 1 tab.

25376 (IAEA-TC-PM–005) **Country programme review. Guatemala.** International Atomic Energy Agency, Vienna (Austria). Div. of Technical Co-operation Programmes. Sep 1992. [25p.] Project INT/0/053. Order Number DE93626611. Source: OSTI; NTIS (US Sales Only); INIS.

This document reviews the current nuclear program in Guatemala, identifying the peaceful uses of nuclear technology in the country and possible future technical co-operation activities. Separate brief sections deal with food and agriculture; human health; radiation protection; industrial applications and hydrology; nuclear analytical techniques; nuclear instrumentation and nuclear information.

25377 (IAEA/UNDP–CPR-85/085-TR) **Manpower development for nuclear power programme. China. Project findings and recommendations: Terminal report. Report prepared for the Government of China.** Csik, B.J. (International Atomic Energy Agency, Vienna (Austria). Nuclear Power Engineering Section). International Atomic Energy Agency, Vienna (Austria); United Nations Development Programme. 1992. [66p.] Project CPR/4/003. Order Number DE93626612. Source: OSTI; NTIS (US Sales Only); INIS.

The United Nations Development Program (UNDP) project was conceived in April 1985, implementation was started on preliminary authorization by summer 1986, and it was approved and signed in early 1987. The duration was originally planned for three years with a UNDP input of US$ 1,657.500 (including Government cost sharing of US$ 280,000). The project is now essentially completed with a few items still pending, though committed as firmly planned, and the current cost estimate is US$ 1,707.617. The objective of the project was to assist in establishing long-term training programmes in two training centres in the People's Republic of China (Qinshan and Suzhou) and strengthen the training capabilities at these centres. The two centres are intended to provide specialized comprehensive training in basic and applied nuclear power engineering disciplines as well as in construction, operation and maintenance of nuclear power plants to technical personnel assigned to the nuclear power plants in the People's Republic of China.

25378 (INIS-BR–3127) **Technology development in materials working for nuclear sector and its consequences for the Brazilian market.** Volta, A.R. NUCLEN, Rio de Janeiro, RJ (Brazil). 1992. [8p.] (In Portuguese). (CONF-9210349–: 4. International Seminar on Technology Transfer; 1. Brazilian Congress on Technology Transfer, Rio de Janeiro (Brazil), 4-9 Oct 1992). Order Number DE93624758. Source: OSTI; NTIS (US Sales Only); INIS.

The technology transfer model adopted in materials development for Brazilian nuclear sector is described. Materials are very important for the industrial development and the National nuclear program has contributed with others areas, for example, metallurgical, siderurgical, equipment sectors, etc. Grafenrheinfeld Power Plant is used like reference plant for Angra-1, a Brazilian nuclear power plant. (M.V.M.).

25379 (NEI-DK–1143) **Latvian research: An international evaluation.** Danish Research Councils, Copenhagen (Denmark). Dec 1992. [710p.] Order Number DE93624759. Source: OSTI; NTIS; INIS.

The Latvian Council of Science asked the Danish Research Councils and the Danish Academy for Technical Sciences for help in evaluating Latvian scientific research. The background for this request was the Latvian desire to stimulate an approach towards full integration in the European society. Based on reports, site visits and interviews, 19 panels of experts covering all subject areas prepared evaluation reports. These detailed evaluations of actual research projects are included in the publication in addition to general recommendations. The panels recommend that Latvian authorities take into consideration when planning scientific research, especially with regard to those branches which contribute to the industrial development and social and economic sciences, that a balance should be made between long range basic, and short range applied, science activities. Despite the very serious economic conditions in Latvia, it was also advised that immediate measures should be taken to ensure a stable funding of the research system as the future development of Latvian society is dependent on the stability and high quality of its research activities. Other recommendations are given in detail. (AB).

25380 (ORAU–91/G-52) **Emergency management training program: Guide to good practice.** Oak Ridge Associated Universities, Inc., TN (United States). Jul 1991. 301p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-76OR00033. Order Number DE93013317. Source: OSTI; NTIS; GPO Dep.

The Emergency Management Training Program Guide to Good Practice is a project of the Training Resources and Data Exchange (TRADE) Emergency Management Issues Special Interest Group (EMI SIG). EMI SIG members expressed interest in a resource to assist in development of a comprehensive emergency management training program. This publication provides guidelines,

methods, and materials for EMI SIG members to use, assisting in complete and effective emergency management programs. The purposes of the Emergency Management Training Program Guide to Good Practice are: Provide guidance in the development and management of Emergency Management (EM) training programs; Assist EM trainers to incorporate components of the DOE Emergency Management System philosophy of planning, preparedness, readiness assurance, and response into EM training programs; Help EM training managers meet EM training requirements and conditions established by current regulations and policies; Supplement other TRADE EMI SIG documents and complement individual facility training documents. This program is designed for emergency management personnel who are responsible for providing or overseeing EM training but who do not necessarily possess expertise in developing training. It provides good practices from the manager's point of view on how to produce, administer, and document facility EM training programs in the spirit of the DOE EM system philosophy. Basic guidance is also included for personnel who design, develop, deliver, and/or evaluate EM training programs or parts. This guidance includes key points of EM training programs and identifies other documents that contain useful and/or more detailed training information.

25381 (POEF-T--3605) **Engineering performance metrics.** DeLozier, R. (Oak Ridge National Lab., TN (United States)); Snyder, N. Martin Marietta Energy Systems, Inc., Piketon, OH (United States). 31 Mar 1993. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-76OR00001. (CONF-930768--1: 3. annual international symposium of the National Council on Systems Engineering, Arlington, VA (United States), 26-28 Jul 1993). Order Number DE93012084. Source: OSTI; NTIS; GPO Dep.

Implementation of a Total Quality Management (TQM) approach to engineering work required the development of a system of metrics which would serve as a meaningful msinagement tool for evaluating effectiveness in accomplishing project objectives and in achieving improved customer satisfaction. A team effort was chartered with the goal of developing a system of engineering performance metrics which would measure customer satisfaction, quality, cost effectiveness, and timeliness. The approach to developing this system involved normal systems design phases including, conceptual design, detailed design, implementation, and integration. The lessons teamed from this effort will be explored in this paper. These lessons teamed may provide a starting point for other large engineering organizations seeking to institute a performance measurement system accomplishing project objectives and in achieving improved customer satisfaction. To facilitate this effort, a team was chartered to assist in the development of the metrics system. This team, consisting of customers and Engineering staff members, was utilized to ensure that the needs and views of the customers were considered in the development of performance measurements. The development of a system of metrics is no different than the development of any type of system. It includes the steps of defining performance measurement requirements, measurement process conceptual design, performance measurement and reporting system detailed design, and system implementation and integration.

25382 (UTTAC--59) **Annual report of the Tandem Accelerator Center, University of Tsukuba: April 1, 1991 - March 31, 1992.** Furuno, K.; Shima, K.; Komatsubara, T. (eds.). Tsukuba Univ., Ibaraki (Japan). Tandem Accelerator Center. Sep 1992. 153p. Order Number DE93788277. Source: OSTI; NTIS; INIS.

This annual report includes the research activities and the technical developments carried out at the Tandem Accelerator Center in University of Tsukuba for the period from April 1991 to March 1992. Research activities covered the following subjects. Experimental investigations were made on (1) nuclear spectroscopy of high-spin rotational states and high-spin isomers in odd-odd nuclei, anomalous Fermi-coupling constant in the β decay of ^{35}Ar and the search for new isotopes around the mass number 90; (2) polarization phenomena in nuclear reactions; (3) the application of energetic heavy ions to solid state physics; (4) the properties of defects in metal produced by proton irradiation; (5) the magnetic properties of $LiVO_2$ by NMR; (6) off line Moessbauer studies; and (7) the mechanism of micro-cluster formation at the surface of material by heavy-ion bombardment. Theoretical work pertinent to the nuclear collective motion and the relativistic mean-field theory is also included in this report. (J.P.N.).

25383 (WHC-SA--1783) **Teamwork, taxes, and training: A case for cooperation and quality.** Hayward, G.B. Westinghouse Hanford Co., Richland, WA (United States). Jan 1993. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. (CONF-930278--4: 1993 American Society for Quality Control (ASQC) audit conference, Charlotte, NC (United States), 25-26 Feb 1993). Order Number DE93011279. Source: OSTI; NTIS; INIS; GPO Dep.

Training to ensure compliance with the myriad of laws and regulations imposed by federal, state, and local governments is a trend that will continue well into the 1990s. The cost of this training increasingly takes away from the bottom line of many companies and adds additional costs to the products and services being developed and sold. This cost is passed on to the consumer. When the government or one of its contractors incurs additional costs, they are passed on to the taxpayer. As budgets shrink and requirements go up it makes sense to find a way to maintain high quality and cut costs. The Quality Training and Resource Center was established at Hanford by the US Department of Energy to do just that; cut costs and maintain quality. This paper will explore the methodology used to establish a model based on contractor cooperation, teamwork, and resource sharing to improve training while Towering costs.

25384 (Y/DJ--35707) **Process Improvement Workbook.** Buckner, K.P.; Leete, R.S. Jr.; West, J.A. Oak Ridge Y-12 Plant, TN (United States). 1 Jan 1993. 65p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OS21400. Order Number DE93011839. Source: OSTI; NTIS; GPO Dep.

This Workbook was written by a team from the Y-12 Quality Division. We have lots of collective experience in improving things, and we assembled our thoughts and ideas. This Workbook is our own idea. For years, we (probably like you) have been exposed to books, videotapes, and courses on the "how-to" of improving things. We found that if you look at all the energy people have put into showing us a better way, and then you look at all the results we have to show for their suggestions and tactics, there is an imbalance. Why don't we have more results to show that improvements have been made? We decided the reason had to be a problem of methods. We decided we had the ingredients, but not the recipe! This is a hands-on Workbook designed for individual or team use. It guides you to improve whatever process you choose. This Workbook ask questions, and your route through it depends on your answers and on the type of improvement you want. You'll use one Workbook for only one process. Each process will have its own Workbook. To use your Workbook, just read the questions and follow the directions. Your notes document what you believe and what you learn from others. Your Workbook will become a handy record of your process. You can use it to explain the process to others, including your Customers and Suppliers.

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Refer also to citation(s) 22682, 22759, 22791, 22859, 22867, 22895, 22900, 22901, 22974, 22995, 23006, 23060, 23063, 23080, 23150, 23151, 23152, 23157, 23217, 23326, 23350, 23373, 23374, 23436, 23447, 23454, 23458, 23465, 23466, 23481, 23482, 23487, 23488, 23489, 23490, 23513, 23514, 23515, 23518, 23531, 23532, 23535, 23536, 23537, 23547, 23612, 23615, 23620, 23627, 23644, 23668, 23678, 23684, 23687, 23724, 23769, 23813, 23817, 23818, 23824, 23840, 23852, 23864, 23896, 23916, 23966, 23976, 24081, 24082, 24135, 24137, 24144, 24147, 24166, 24170, 24171, 24173, 24179, 24181, 24185, 24240, 24250, 24251, 24277, 24286, 24295, 24298, 24310, 24322, 24325, 24328, 24329, 24361, 24382, 24391, 24466, 24491, 24492, 24495, 24497, 24500, 24502, 24503, 24520, 24523, 24558, 24565, 24567, 24631, 24638, 24651, 24652, 24655, 24762, 24828, 24833, 24877, 24894, 24900, 24901, 24947, 24949, 24956, 24959, 24961, 24973, 25000, 25003, 25008, 25013, 25038, 25061, 25155, 25157, 25161, 25163, 25164, 25166, 25167, 25202, 25203, 25204, 25271, 25273, 25274, 25285, 25316, 25344

25385 (ANL/MCS/CP–79562) **Toward a verifiable approach to the design of concurrent computations.** Chisholm, G.H. Argonne National Lab., IL (United States). [1993]. 13p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-930372–11: 1993 international simulators conference on high performance computing, Arlington, VA (United States), 29 Mar - 1 apr 1993). Order Number DE93012908. Source: OSTI; NTIS; GPO Dep.

Distributed programs are dependent on explicit message passing between disjoint components of the computation. This paper is concerned with investigating an approach for proving correctness of distributed programs under an assumed data-exchange capability. Stated informally, the data exchange assumption is that every message is passed correctly, i.e., neither lost nor corrupted. One approach for constructing a proof under this assumption would be to embed an abstract model of the data communications mechanism into the program specification. The Message Passing Interface (MPI) standard provides a basis for such a modal. In support of our investigations, we have developed a high-level specification using the ASLAN specification language. Our specification is based on a generalized communications model from which the MPI modelmay be derived. We describe the specification of this model and an approach to the specification of distributed programs with explicit message passing based on a verifiable data exchange model.

25386 (BNL–48759) **Self organized criticality.** Creutz, M. Brookhaven National Lab., Upton, NY (United States). Mar 1993. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-9302112–1: Madi Gras conference on concurrent computing in the physical sciences, Baton Rouge, LA (United States), 18-20 Feb 1993). Order Number DE93013182. Source: OSTI; NTIS; INIS; GPO Dep.

Self organized criticality refers to the tendency of highly dissipative systems to drive themselves to a critical state. This has been proposed to explain why observed physics often displays a wide disparity of length and time scales. The phenomenon can be studied in simple cellular automaton models.

25387 (CEA-CONF–11246) **New improvements in the self-shielding formalism of the Apollo-2 code.** Coste, M.; Tellier, H.; Ribon, P.; Raepsaet, V.; Van der Gucht, C. CEA Centre d'Etudes de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Mecanique et de Technologie. 1993. [5p.] (CONF-930404–: International topical meeting on mathematical methods and supercomputing in nuclear applications (M&C+SNA '93), Karlsruhe (Germany), 19-23 Apr 1993). Order Number DE93626601. Source: OSTI; NTIS (US Sales Only); INIS.

One important modelization of a transport code working on a coarse energy mesh is the self-shielding. The French transport code APPOLO 2, developed at the Commissariat a l'Energie Atomique, uses a self-shielding formalism based on a double equivalence. First a homogenization gives the reaction rates in a heterogeneous geometry, and then a multigroup equivalence gives, once the reaction rates are known, the self-shielded cross-sections. The homogenization is a very sensitive part because it is the one which requires physical modelizations. We have added a new model which allows us to treat numerous narrow resonances statistically distributed in the same group of the multigroup mesh. It is important to notice that for a narrow resonance isolated in a group, that new model is equivalent to the previous narrow resonance model (NR).

25388 (CONF-930245–) **Privacy and Security Research Group workshop on network and distributed system security: Proceedings.** Lawrence Livermore National Lab., CA (United States). 1993. 135p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. From Privacy and Security Research Group workshop on network and distributed systems security; San Diego, CA (United States); 11-12 Feb 1993. Order Number DE93010504. Source: OSTI; NTIS; GPO Dep.

This report contains papers on the following topics: NREN Security Issues: Policies and Technologies; Layer Wars: Protect the Internet with Network Layer Security; Electronic Commission Management; Workflow 2000 - Electronic Document Authorization in Practice; Security Issues of a UNIX PEM Implementation; Implementing Privacy Enhanced Mail on VMS; Distributed Public Key Certificate Management; Protecting the Integrity of Privacy-enhanced Electronic Mail; Practical Authorization in Large Heterogeneous Distributed Systems; Security Issues in the Truffles File System; Issues surrounding the use of Cryptographic Algorithms and Smart Card Applications; Smart Card Augmentation of Kerberos; and An Overview of the Advanced Smart Card Access Control System.

25389 (CONF-9305151–) **Fifteenth Department of Energy Computer Security Group training conference: Mission possible: Connected and protected: Proceedings.** USDOE Office of Administration and Management, Washington, DC (United States). [1993]. 244p. Sponsored by USDOE, Washington, DC (United States). From 15. computer security group training conference: mission possible - connected and protected; Albuquerque, NM (United States); 3-6 May 1993. Order Number DE93011853. Source: OSTI; NTIS; GPO Dep.

These proceedings from the March 1993 conference contain eighteen papers on various methods for maintaining computer security. Systems for protecting computer networks are described, as well as microcomputers and personal computers. Safeguards for illegal intrusions from both outsiders and insiders are reported. Also, training efforts to prevent intrusions into computer networks are described. Individual papers are abstracted separately.

25390 (DL-SCI-TM–88-E) **REX - a program for the analysis of X-ray reflectivity data: user guide and programmer manual.** Crabb, T.A. (Commission of the European Communities, Ispra (Italy). Joint Research Centre); Gibson, P.N.; Roberts, K.J. Daresbury Lab. (United Kingdom). Dec 1992. [41p.] Order Number DE93626602. Source: OSTI; NTIS (US Sales Only); INIS.

A FORTRAN program REX, which has been developed to facilitate the interpretation of X-ray reflectivity data, is described. The program allows the simulation of reflectivity profiles as a function of either incident angle or of energy. Factors such as anomalous dispersion, and surface and interface roughness are taken into account in the model. In addition, experimental data of reflectivity as a function of incident angle can be matched to user-supplied theoretical parameters by a least-squares refinement procedure. Experimental reflectivity data recorded at several X-ray wavelengths can be analysed simultaneously, thus eliminating certain experimental errors. (author).

25391 (DOE/ER–0536) **The DOE Program in High-Performance Computing and Communications (HPCC).** USDOE Office of Energy Research, Washington, DC (United States). Office of Scientific Computing. Mar 1993. 99p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93013813. Source: OSTI; NTIS; GPO Dep.

This document is intended to serve two purposes. Its first purpose is to report to Congress, as mandated in the High-Performance Computing Act of 1991, the considerable progress that the Department of Energy has made in 1992 toward achieving the goals of the High-Performance Computing and Communications (HPCC) Program. Its second purpose is to provide a snapshot of and an introduction to the many programs administered by the Office of Scientific Computing under the auspices of the HPCC Program.

25392 (DOE/ER/25047–5) **Optimization and eigenvalue computation with application to meteorology and oceanography: Progress report, August 1, 1992–July 31, 1993.** Nocedal, J. Northwestern Univ., Evanston, IL (United States). May 1993. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-87ER25047. Order Number DE93015310. Source: OSTI; NTIS; GPO Dep.

Our computational experience has shown that dynamic scaling techniques can have a dramatic effect in the efficiency of optimization algorithms, especially when the number of variables is very large. Conjugate gradient and limited memory methods do not have adequate information on the Hessian matrix and dynamic scaling of the variables can supply some of this missing information. In [1] we developed a full-rank scaling technique for variable metric methods that is globally and superlinearly convergent on general problems. We have also proposed a new technique for accelerating the optimization process in the solution of data assimilation problems. This

is an area where optimization plays a crucial role, since the four dimensional assimilation approach consists of using a nonlinear optimization code to adjust the initial conditions of the model so that measurements distributed in space and time can be adequately predicted. Each iteration of the optimization method requires a full simulation of the model a process that typically takes 1 hour on the CRAY 90. We have found that by computing a few extreme eigenvalues of the Hessian matrix, and by incorporating this information in a limited memory code, the number of simulations can be reduced by at least 50%. This is highly significant and represents a substantial contribution to the area of variational assimilation of data. We have also developed an extension of the limited memory BFGS method that is capable of handling simple bounds on the variables, providing more freedom to the modeler [2]. This work was possible by the development of compact matrix representations of limited memory matrices [3], which keep the computation cost of the iteration to a minimum. Indeed we have shown that the operations with limited memory BFGS matrices are optimal in terms of arithmetic operations, since they can be rewritten as the reverse automatic differentiation of an auxiliary function [4].

25393 (DOE/ER/25136–1) **Newton iterative methods for large scale nonlinear systems: Progress report, 1992–1993.** Walker, H.F.; Turner, K. Utah State Univ., Logan, UT (United States). Dept. of Mathematics and Statistics. [1993]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-92ER25136. Order Number DE93015357. Source: OSTI; NTIS; GPO Dep.

Objective is to develop robust, efficient Newton iterative methods for general large scale problems well suited for discretizations of partial differential equations, integral equations, and other continuous problems. A concomitant objective is to develop improved iterative linear algebra methods. We first outline research on Newton iterative methods and then review work on iterative linear algebra methods. (DLC)

25394 (EGG–10617-6097) **An alternative to sneakernet.** Orrell, S.; Ralstin, S. EG and G Energy Measurements, Inc., Albuquerque, NM (United States). Kirtland Operations. [1993]. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC08-88NV10617. (CONF-9305151–1: 15. computer security group training conference: mission possible - connected and protected, Albuquerque, NM (United States), 3-6 May 1993). Order Number DE93012130. Source: OSTI; NTIS; GPO Dep.

Security plans for classified computer systems often specify that only a small percentage of the data processed will be classified. Thus, the bulk of the data on such secure systems is unclassified. This situation requires that some mechanism be provided for moving files to or from the open environment. For many years, this has been accomplished by writing selected files to a magnetic medium, and carrying it to another system where the files are retrieved. These procedures, in many cases, have been developed informally and ad hoc to a specific transfer requirement. This media transport process, referred to as sneakernet, often is manually logged, if at all, and controlled only by administrative procedures. While sneakernets may isolate secure systems from direct attack, other security concerns remain. There has been little guidance available for handling such transfers in a secure manner. Comprehensive criteria for the security evaluation of the procedures used for these transfers have yet to be published. This paper examines the security concerns associated with transfers of unclassified files between security environments and develops a set of criteria which can be used in evaluating the security of any system or procedure for that purpose. Methods for bidirectional unclassified file transfer between secure and open environments could range from completely manual to fully automated. The criteria developed, however, are intended to be generic and to apply to any system for the purpose, existing or proposed.

25395 (EGG-CODP–10620(3-93)) **EXCHANGE: Volume 3-93, March 1993.** Boltz, J.C. (ed.). EG and G Idaho, Inc., Idaho Falls, ID (United States). Mar 1993. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-76ID01570. Order Number DE93012169. Source: OSTI; NTIS; GPO Dep.

This report discusses the following topics on computer environments: Releasing computer software outside EG&G Idaho; Ilford digital photo imager; mandatory upgrade of PC ORPS software; ORPS host computer upgrade; EROB computer users see network change; password expiration notice; big iron still has place in HPC market; handy scripts to copy and move files; more on workstation password expiration; training center course schedule for April 1993; Microsoft Word Version 5.1a- button bar; file attributes can provide you greater flexibility; constructing a personal WordPerfect dictionary; and Windows shortcuts.

25396 (EGG-M–92595) **Intelligent scheduling support for the US Coast Guard.** Darby-Dowman, K. (Brunel Univ., Uxbridge (United Kingdom)); Lucas, C.; Mitra, G.; Fink, R.; Kingsley, L.; Smith, J.W. EG and G Idaho, Inc., Idaho Falls, ID (United States). [1992]. 18p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-76ID01570. (CONF-9211227–1: Intelligent scheduling systems symposium, San Francisco, CA (United States), 1 Nov 1992). Order Number DE93010802. Source: OSTI; NTIS; GPO Dep.

This paper will discuss a joint effort by the U.S. Coast Guard Research & Development Center, Idaho National Engineering Laboratory and Brunel University to provide the necessary tools to increase the human scheduler's capability to handle the scheduling process more efficiently and effectively. Automating the scheduling process required a system that could think independently of the scheduler, that is, the systems needed its own control mechanism and knowledge base. Further, automated schedule generation became a design requirement and sophisticated algorithms were formulated to solve a complex combinatorial problem. In short, the resulting design can be viewed as a hybrid knowledge-based mathematical programming application system. This document contains an overview of the integrated system, a discrete optimization model for scheduling, and schedule diagnosis and analysis.

25397 (ESTSC–000337C017500) **PDQ7: 1,2 or 3-d few-gp diffusion depletion.** Pruitt, S.J. (Boeing Computer Services, Richland, WA (United States)). Boeing Computer Services Co., Richland, WA (United States). 1 Jan 1980. Sponsored by USDOE, Washington, DC (United States). (NESC–275). Source: ESTSC.

Description: CYBER175; NOS 1.2 (CDC CYBER175); SCOPE 2.FORTRAN IV and COMPASS; 1 Mag Tape.

The PDQ series of programs is designed to solve the neutron diffusion-depletion problem in one, two or three dimensions. The three-dimensional spatial calculation may be either explicit or discontinuous trial function synthesis. Up to five lethargy groups are permitted. Adjoint, fixed source, one iteration, additive fixed source, eigenvalue, and boundary value calculations may be performed. The programs utilize the HARMONY system for time-dependent representation of cross section variation and generalized depletion chain solutions. Geometries available include rectangular, cylindrical, spherical, and hexagonal. All allow variable mesh in all dimensions. Various control searches as well as temperature and xenon feedback are provided.

25398 (ESTSC–000581IBMPC00) **APS1.1: Costs of Building Waste Facilities; Price Per Shipment to Recoup Costs.** Boyd, K. (EG and G Idaho Inc., Idaho Falls, ID (United States)); Branham-Haar, K.A.; Smith, P. EG and G Idaho, Inc., Idaho Falls, ID (United States). 1 May 1993. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-76ID01570. Source: ESTSC.

Description: IBM PC; MS-DOS 5.0; Modula-2; 1 3.5 Diskette. Calls to M2SAGE, a library of reusable Modula-2 code, represent approximately 33 percent of the code. .EXE indicates executable modules, .DFL indicates the data dictionary, .DAT and .IDX indicate the data and index files, .DOC indicates user manual documentation. PKZIP 2.046 used to compress/uncompress files. APS.DOC is the user manual. It was created using Word Perfect 5.1. It is intended for print out to an Hewlett Packard Laser-Jet III or better with fully scalable fonts.

The Automated Pricing Schedule is a computer model for evaluating the economics of developing, operating, and closing a low-level radioactive waste disposal site. It provides pricing for individual shipments based on the characteristics of the shipment, and calculates a disposal fee to be charged for each shipment to recover the costs of the facility. It includes a sensitivity analysis module to evaluate the effect of varying the parameters of the model.

25399 (ESTSC–000583I037000) **TRIPM: Water & Solute Transport Porous Media.** Gureghian, A.B. (Battelle Columbus Labs, OH (United States)). Battelle Memorial Inst., Columbus, OH (United States). Office of Nuclear Waste Isolation. 1 May 1983. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-83CH10140. (NESC–1028). Source: ESTSC.

Description: IBM370; OS/MVT (IBM370); MVS (IBM3033); FORTRAN IV; 1 Mag Tape. The user must properly DIMENSION the BAND, BANDP, and BANDG arrays in the MAIN routine for each TRIPM problem. Generally, the user will be able to determine the proper values for a simple mesh configuration; however, for an elaborate mesh the user can obtain the proper values from TRIPM output by an abbreviated run, if necessary. To produce graphic output, TRIPM uses the Integrated Software Systems Corporation's (ISSCO) proprietary graphics software product, DISSPLA which is not included in the package.

TRIPM is a mathematical model designed to predict the transport of radionuclides and their decay products in a saturated-unsaturated vertical plane of a phreatic aquifer under isothermal conditions. The model is composed of two modules: the first calculates the pressure distribution in the domain of interest, enabling one to compute the velocities and soil moisture; the second calculates the migration of the various species by taking into account the major processes associated with the transport phenomena of a dissolved substance in porous media, i.e. advection, mechanical dispersion, molecular diffusion, radioactive decay and sorption. The influence of soil-water pH on the distribution coefficient is also considered. The first module may be used independently of the second.

25400 (ESTSC–000584IBMPC00) **DIAMANT-2: Transport Code for Regular Triangular Geometry.** Kufner, K. (Kernforschungszentrum Karlsruhe GmbH, Karlsruhe (Germany)); Burkhard, J.; Heger, R. OECD Nuclear Energy Agency, 75 - Paris (France). 1 Jun 1987. Sponsored by National Endowment for the Arts, Washington, DC (United States). (NESC–NEA0672). Source: ESTSC.

Description: IBM PC; MS-DOS 4.01; FORTRAN 77; 2 3.5 Diskettes. This code was designed to run under control of the modular code system KAPROS but it can also be used as stand-alone code. It is recommended to replace the sytem-dependent timing functions TASKTI and TIMLIM by local equivalents.

DIAMANT2 solves the two-dimensional static multigroup neutron transport equation in planar regular triangular geometry. Both regular and adjoint, inhomogeneous and homogeneous problems subject to vacuum, reflective or input specified boundary flux conditions are solved. Anisotropy is allowed for the scattering source. Volume and surface sources are allowed for inhomogeneous problems.

25401 (ESTSC/NRC/R–000003IBMPC03) **IRRAS4.15: Integrated Reliability and Risk Analysis.** Russell, K.D. (EG and G Inc., Idaho Falls, ID (United States)). EG and G Idaho, Inc., Idaho Falls, ID (United States). 1 Nov 1992. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Regulatory Research. DOE Contract AC07-76ID01570. Source: ESTSC.

Description: IBM PC; IBM/Microsoft DOS version 3.3 orMODULA-2; 3 5.25 Diskettes. This software uses the Media Cybernetics HALO graphical support routines. The run time files are included with the software and can be distributed with this software as a license has been acquired. Since no source code or sample problems were included in the submittal of this package, the executable, as submitted by author, was evaluated with a limited testing procedure.

IRRAS4.15 is a program developed for the purpose of performing those functions necessary to create and analyze a complete Probabilistic Risk Assessment(PRA). This program includes functions to allow the user to create event trees and fault trees, to define accident sequences and basic event failure data, to solve system and accident sequence fault trees, to quantify cut sets, and to perform uncertainty analysis on the results. Also included in this program are features to allow the analyst to generate reports and displays that can be used to document the results of an analysis. Since this software is a very detailed technical tool, the user of this program should be familiar with PRA concepts and the methods used to perform these analyses.

25402 (IC–93/65) **The RNA world, automatic sequences and oncogenetics.** Tahir Shah, K. International Centre for Theoretical Physics, Trieste (Italy). Apr 1993. [40p.] Order Number DE93624727. Source: OSTI; NTIS (US Sales Only); INIS.

We construct a model of the RNA world in terms of naturally evolving nucleotide sequences assuming only Crick-Watson base pairing and self-cleaving/splicing capability. These sequences have the following properties. (1) They are recognizable by an automation (or automata). That is, to each k-sequence, there exist a k-automation which accepts, recognizes or generates the k-sequence. These are known as automatic sequences. Fibonacci and Morse-Thue sequences are the most natural outcome of prebiotic chemical conditions. (2) Infinite (resp. large) sequences are self-similar (resp. nearly self-similar) under certain rewrite rules and consequently give rise to fractal (resp.fractal-like) structures. Computationally, such sequences can also be generated by their corresponding deterministic parallel re-write system, known as a DOL system. The self-similar sequences are fixed points of their respective rewrite rules. Some of these automatic sequences have the capability that they can read or "accept" other sequences while others can detect errors and trigger error-correcting mechanisms. They can be enlarged and have block and/or palindrome structure. Linear recurring sequences such as Fibonacci sequence are simply Feed-back Shift Registers, a well know model of information processing machines. We show that a mutation of any rewrite rule can cause a combinatorial explosion of error and relates this to oncogenetical behavior. On the other hand, a mutation of sequences that are not rewrite rules, leads to normal evolutionary change. Known experimental results support our hypothesis. (author). Refs.

25403 (INIS-mf–13503, pp. 12-15) **Automatic creation of simulation configuration: The SIPA workshop: SWORD.** Oudot, G. (Thomson-CSF Simulator Department, Cergy-Pontoise (France)); Poizat, F. European Nuclear Society (ENS), Bern (Switzerland); Czech Nuclear Society, Prague (Czech Republic); Slovak Nuclear Society, Bratislava (Slovakia). Jan 1993. (CONF-921068–: East-West topical meeting: the safe and reliable operation of light water reactor NPP's, Prague (Czechoslovakia), 18-21 Oct 1992). In *Topform '92: the safe and reliable operation of LWR NPPs. Vol. II: Poster papers.* [245p.] Order Number DE93625345. Source: OSTI; NTIS (US Sales Only); INIS.

SIPA, which stands for 'Simulator for Post Accident', includes: (1) a sophisticated software oriented workshop SWORD (which stands for 'Software Workshop Oriented towards Research and Development') designed in the ADA language including integrated CAD system and software tools for automatic generation of simulation software and man-machine interface in order to operate run-time simulation; (2) a 'simulator structure' based on hardware equipment and software for supervision and communications; (3) simulation configuration generated by SWORD, operated under the control of the 'simulator structure' and run on a target computer. SWORD has already been used to generate two simulation configurations (French 900 MW and 1300 MW nuclear power plants), which are now fully operational on the SIPA training simulator. (Z.S.) 1 ref.

25404 (JAERI-M–93-033) **Proceedings of the 8th topical meeting on nuclear code development.** Japan Atomic Energy Research Inst., Tokyo (Japan). Mar 1993. 253p. (In Japanese, English). (CONF-9211246–: 8. topical meeting on nuclear code development, Tokai (Japan), 11-12 Nov 1992). Order Number DE93797613. Source: OSTI; NTIS; INIS.

The 8th Topical Meeting on Nuclear Code Development, organized by Committee on Reactor Physics and Nuclear Codes Committee of Japan Atomic Energy Research Institute (JAERI), was held at Tokai Research Establishment of JAERI, on 11th and 12th of November, 1992. In the meeting, 14 papers were presented on the topics of (1) the next generation nuclear reactor design system and (2) advances of the nuclear fuel reprocessing safety analysis codes. These papers are compiled in this proceedings. (author).

25405 (JINR-E–11-91-560) **Blackboard architecture and qualitative model in a computer aided assistant designed to**

define computers for HEP computing. Nodarse, F.F.; Ivanov, V.G. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of Computing Techniques and Automation. 1991. [16p.] Order Number DE93626603. Source: OSTI; NTIS (US Sales Only); INIS.

Using BLACKBOARD architecture and qualitative model, an expert systm was developed to assist the use in defining the computers method for High Energy Physics computing. The COMEX system requires an IBM AT personal computer or compatible with than 640 Kb RAM and hard disk. 5 refs.; 9 figs.

25406 (JINR-R-5-91-559) **On a convergence of iterative Newton's scheme.** Zhanlav, T.; Puzynin, I.V. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of Computing Techniques and Automation. 1991. [8p.] (In Russian). Order Number DE93626604. Source: OSTI; NTIS (US Sales Only); INIS.

The continuous analog of Newton's method is studied. The algorithm for calculating the iterative parameter is given and the convergence of iterative Newton's scheme for solving the nonlinear functional equation in Banach space is established. 8 refs.

25407 (KFKI-1992-25/G) **Logic based feature detection on incore neutron spectra.** Bende-Farkas, S. (Hungarian Academy of Sciences, Budapest (Hungary). Central Research Inst. for Physics); Kiss, S.; Racz, A. Hungarian Academy of Sciences, Budapest (Hungary). Central Research Inst. for Physics. Sep 1992. [18p.] (CONF-9206369–: IMORN-23, Nykoeping (Sweden), 3-5 Jun 1992). Order Number DE93626605. Source: OSTI; NTIS (US Sales Only); INIS.

A methodology is proposed to investigate neutron spectra in such a way which is similar to human thinking. The goal was to save experts from tedious, mechanical tasks of browsing a large amount of signals in order to recognize changes in the underlying mechanisms. The general framework for detecting features of incore neutron spectra with a rulebased methodology is presented. As an example, the meaningful peaks in the APSDs are determined. This method is a part of a wider project to develop a noise diagnostic expert system. (R.P.) 6 refs.; 6 figs.; 1 tab.

25408 (LA-UR-92-3770) **Completing fault models for abductive diagnosis.** Knill, E. (Los Alamos National Lab., NM (United States)); Cox, P.T.; Pietrzykowski, T. Los Alamos National Lab., NM (United States). 5 Nov 1992. 21p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930848–1: 13. international joint conference on artificial intelligence, Chambery, Savoie (France), 29 Aug - 3 sep 1993). Order Number DE93003832. Source: OSTI; NTIS; GPO Dep.

In logic-based diagnosis, the consistency-based method is used to determine the possible sets of faulty devices. If the fault models of the devices are incomplete or nondeterministic, then this method does not necessarily yield abductive explanations of system behavior. Such explanations give additional information about faulty behavior and can be used for prediction. Unfortunately, system descriptions for the consistency-based method are often not suitable for abductive diagnosis. Methods for completing the fault models for abductive diagnosis have been suggested informally by Poole and by Cox et al. Here we formalize these methods by introducing a standard form for system descriptions. The properties of these methods are determined in relation to consistency-based diagnosis and compared to other ideas for integrating consistency-based and abductive diagnosis.

25409 (LA-UR-93-1659) **The FBI wavelet/scalar quantization standard for gray-scale fingerprint image compression.** Bradley, J.N. (Los Alamos National Lab., NM (United States)); Brislawn, C.M.; Hopper, T. Los Alamos National Lab., NM (United States). [1993]. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930445–13: Society of Photo-Optical Instrumentation Engineers (SPIE) OE/aerospace science and sensing meeting, Orlando, FL (United States), 11-16 Apr 1993). Order Number DE93012706. Source: OSTI; NTIS; GPO Dep.

The FBI has recently adopted a standard for the compression of digitized 8-bit gray-scale fingerprint images. The standard is based on scalar quantization of a 64-subband discrete wavelet transform decomposition of the images, followed by Huffman coding. Novel features of the algorithm include the use of symmetric boundary conditions for transforming finite-length signals and a subband decomposition tailored for fingerprint images scanned at 500 dpi. The standard is intended for use in conjunction with ANSI/NBS-CLS 1-1993, American National Standard Data Format for the Interchange of Fingerprint Information, and the FBI's Integrated Automated Fingerprint Identification System.

25410 (LLNL-M-276-Rev.2) **PANACEA user's manual for PANACEA Version 2.0: Revision 2.** Brown, S.A.; Braddy, D. Lawrence Livermore National Lab., CA (United States). 4 Jan 1993. 99p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE93012502. Source: OSTI; NTIS; GPO Dep.

A numerical simulation code is fundamentally a device to solve an initial value problem. Very often these programs are written starting with the routines that solve some system of equations. Unless care is taken to formulate these routines with regard to a host of issues (e.g., data flow), it can be very awkward to set up a problem or to look at the answers that the code returns. Furthermore, it can be nearly impossible to take advantage of some of the excellent work that various groups have done (e.g., equation solver packages) because the data flow and structuring issues have not been given sufficient attention in the program design stages. One way to avoid some of these difficulties is to write the data flow controls, the I/O mechanisms, and the database manager first. With these parts in place, there is a great deal of guidance for building the parts of a simulation code that deal with the specific set of equations to be solved; thus initial value data is fed in and the solution is written out clearly and conveniently. Furthermore, this approach provides a basis for defining some conventions to allow the sharing of simulation modules. It also helps isolate the machine dependencies of a code in a very few places, which greatly enhances the portability of the code. PANACEA is a library of routines built to address these issues. In essence, PANACEA attempts to embody all of the functionality of a numerical simulation code, which is generic to all simulation codes. It accomplishes this by implementing a model of the simulation as a system of services (routines), which are bound together with the simulation specific routines provided by the code developer. One useful result of this approach is that it effectively imposes a discipline for the development of simulation codes that promote shareability, portability, and inter-operability.

25411 (NAL-TR-1154) **Simulation of a parallel computer.** Harada, K. (National Aerospace Laboratory, Tokyo (Japan)); Yoshida, M.; Nakamura, K. National Aerospace Lab., Chofu, Tokyo (Japan). May 1992. 36p. (In Japanese). Order Number DE93793618. Source: OSTI; NTIS; Available from National Aerospace Laboratory, 44-1, Shindaiji Higashicho 7-chome, Chofu-City, Tokyo, Japan.

A simulation program and an assembler were prepared for a parallel computer with 128× 256 operators operating under a numerical simulator at National Aerospace Laboratory. Examples of evaluation on the parallel computer, estimation of its maximum performance, and the case comparing the parallel computer with one processing element one described. The developed assembler operates on FACOM-M780, and converts the starting program into a machine language for the parallel computer. The verifying simulation used a program to derive a maximum value in data in the array data memory elements and a program to analyze flow fields around a two-dimensional cylinder. The former simulation presented that consistency in the command system for mask operation is more important than network improvement. This should be given due considerations when handling a three-dimensional problem with a large number of data in the memory elements. In the latter simulation, such results were obtained that vorticity computation can be expected of performance corresponding to the number of operators, that computing the flow functions achieved the expectation at 60% (performance improvement is possible), and computing surface pressure, resistance and lift resulted in low efficiency (because of data transfer processing time). 17 refs., 28 figs., 8 tabs.

25412 (NUREG/CR-6035) **Feasibility study for improved steady-state initialization algorithms for the RELAP5 computer code: Phase 1 improved steady-state initialization algorithms for computer codes.** Paulsen, M.P. (Computer Simulation and Analysis, Inc., Idaho Falls, ID (United States)); Peterson, C.E.;

Katsma, K.R. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Systems Research; Computer Simulation and Analysis, Inc., Idaho Falls, ID (United States). Apr 1993. 64p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). Source: OSTI; INIS; GPO; NTIS (documentation only); ESTSC (complete software package), P.O. Box 1020, Oak Ridge, TN 37831-1020.

A design for a new steady-state initialization method is presented that represents an improvement over the current method used in RELAP5. Current initialization methods for RELAP5 solve the transient fluidflow balance equations simulating a transient to achieve steady-state conditions. Because the transient solution is used, the initial conditions may change from the desired values requiring the use of controllers and long transient running times to obtain steady-state conditions for system problems. The new initialization method allows the user to fix thermal-hydraulic values in volumes and junctions where the conditions are best known and have the code compute the initial conditions in other areas of the system. The steady-state balance equations and solution methods are presented. The constitutive, component, and specialpurpose models are reviewed with respect to modifications required for the new steady-state initialization method. The requirements for user input are defined and the feasibility of the method is demonstrated with a testbed code by initializing some simple channel problems. The initialization of the sample problems using, the old and the new methods are compared.

25413 (ORNL/FTR–4371) **[Parallel processing conferences in France]: Foreign trip report, August 31–September 9, 1992.** Walker, D.W. Oak Ridge National Lab., TN (United States). 14 Sep 1992. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93012243. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The traveler first attended the CONPAR 92/VAPP V Joint Conference on Vector and Parallel Processing. The conference featured many presentations and other activities of interest to ORNL research programs using advanced architecture computing systems, particularly in the area of distributed memory concurrent computing. Following this the traveler attended the CNRS-NSF Workshop on Environments and Tools for Parallel Scientific Processing, where he presented an invited talk describing recent joint research at ORNL and the University of Tennessee, Knoxville, on developing a software library for performing linear algebra computations on distributed memory concurrent computers. The traveler held numerous technical discussions on issues having direct relevance to ORNL research programs.

25414 (ORNL/FTR–4402) **Participation in the COMPSTAT 1992 symposium on computation statistics: Foreign trip report, August 22–September 12, 1992.** Ostrouchov, G. Oak Ridge National Lab., TN (United States). 28 Sep 1992. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93012114. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The traveler first participated in the COMPSTAT 1992 Symposium on Computational Statistics. The symposium contained many presentations and other activities of interest to ORNL research programs that perform data analysis and scientific computing, in particular work requiring advanced statistical computing methods. Here, the traveler, presented a talk describing his recent research in global model search as an exploratory data analytic tool made possible by recent advances in computing systems. Following this, the traveler participated in the Interdisciplinary Short Course on Large Scale Scientific Computing. This was the first such course that emphasized the interdisciplinary aspect of large-scale scientific computing. The traveler held numerous technical discussions on issues having direct relevance to ORNL research programs.

25415 (ORNL/TM–12231) **A proposal for a user-level, message passing interface in a distributed memory environment.** Dongarra, J.J. (Tennessee Univ., Knoxville, TN (United States). Dept. of Computer Science); Hempel, R.; Hey, A.J.G.; Walker, D.W. Oak Ridge National Lab., TN (United States). Feb 1993. 71p. Sponsored by USDOE, Washington, DC (United States); Department of Defense, Washington, DC (United States). DOE Contract AC05-84OR21400. Contract DAAL03-91-C-0047. Order Number DE93013456. Source: OSTI; NTIS; GPO Dep.

This paper describes Message Passing Interface 1 (MPI1), a proposed library interface standard for supporting point-to-point message passing. The intended standard will be provided with Fortran 77 and C interfaces, and will form the basis of a standard high level communication environment featuring collective communication and data distribution transformations. The standard proposed here provides blocking, nonblocking, and synchronized message passing between pairs of processes, with message selectivity by source process and message type. Provision is made for noncontiguous messages. Context control provides a convenient means of avoiding message selectivity conflicts between different phases of an application. The ability to form and manipulate process groups permits task parallelism to be exploited, and is a useful abstraction in controlling certain types of collective communication.

25416 (ORNL/TM–12287) **The KSR1: Experimentation and modeling of poststore.** Rosti, E. (Milan Univ. (Italy). Dipt. di Scienze dell'Informazione); Smirni, E.; Wagner, T.D.; Apon, A.W.; Dowdy, L.W. Oak Ridge National Lab., TN (United States). Feb 1993. 34p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93012539. Source: OSTI; NTIS; GPO Dep.

Kendall Square Research introduced the KSR1 system in 1991. The architecture is based on a ring of rings of 64-bit microprocessors. It is a distributed, shared memory system and is scalable. The memory structure is unique and is the key to understanding the system. Different levels of caching eliminates physical memory addressing and leads to the ALLCACHE™ scheme. Since requested data may be found in any of several caches, the initial access time is variable. Once pulled into the local (sub)cache, subsequent access times are fixed and minimal. Thus, the KSR1 is a Cache-Only Memory Architecture (COMA) system.This paper describes experimentation and an analytic model of the KSR1. The focus is on the poststore programmer option. With the poststore option, the programmer can elect to broadcast the updated value of a variable to all processors that might have a copy. This may save time for threads on other processors, but delays the broadcasting thread and places additional traffic on the ring. The specific issue addressed is to determine under what conditions poststore is beneficial. The analytic model and the experimental observations are in good agreement. They indicate that the decision to use poststore depends both on the application and the current system load.

25417 (ORNL/TM–12375) **Proceedings of the Seventh International Symposium on Methodologies for Intelligent Systems (Poster Session).** Harber, K.S. (ed.). Oak Ridge National Lab., TN (United States). May 1993. 174p. Sponsored by USDOE, Washington, DC (United States); Department of Defense, Washington, DC (United States). DOE Contract AC05-84OR21400. (CONF-9306151–: 7. international symposium on methodologies for intelligent systems, Trondheim (Norway), 15-18 Jun 1993). Order Number DE93013470. Source: OSTI; NTIS; GPO Dep.

This report contains the following papers: Implications in vivid logic; a self-learning Bayesian Expert System; a natural language generation system for a heterogeneous distributed database system; "competence-switching" managed by intelligent systems; strategy acquisition by an artificial neural network: Experiments in learning to play a stochastic game; viewpoints and selective inheritance in object-oriented modeling; multivariate discretization of continuous attributes for machine learning; utilization of the case-based reasoning method to resolve dynamic problems; formalization of an ontology of ceramic science in CLASSIC; linguistic tools for intelligent systems; an application of rough sets in knowledge synthesis; and a relational model for imprecise queries. These papers have been indexed separately.

25418 (PNL-SA–21790) **Parallel inverse iteration with reorthogonalization.** Fann, G.I.; Littlefield, R.J. Pacific Northwest Lab., Richland, WA (United States). Mar 1993. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-930331–10: 6. Society for Industrial and Applied Mathematics (SIAM) conference on parallel processing for scientific computing, Norfolk, VA (United States), 21-24 Mar 1993). Order Number DE93012867. Source: OSTI; NTIS; GPO Dep.

A parallel method for finding orthogonal eigenvectors of real symmetric tridiagonal is described. The method uses inverse iteration with repeated Modified Gram-Schmidt (MGS) reorthogonalization of the unconverged iterates for clustered eigenvalues. This approach is more parallelizable than reorthogonalizing against fully converged eigenvectors, as is done by LAPACK's current DSTEIN routine. The new method is found to provide accuracy and speed comparable to DSTEIN's and to have good parallel scalability even for matrices with large clusters of eigenvalues. We present al results for residual and orthogonality tests, plus timings on IBM RS/6000 (sequential) and Intel Touchstone DELTA (parallel) computers.

25419 (RAL–92-076) **HUMPF [Heterogeneous Unix Montecarlo Production Facility] users guide.** Cahill, P.; Edgecock, R.; Fisher, S.M.; Gee, C.N.P.; Gordon, J.C.; Kidd, T.; Leake, J.; Rigby, D.J.; Roberts, J.H.C. Rutherford Appleton Lab., Chilton (United Kingdom). Nov 1992. [24p.] Order Number DE93626606. Source: OSTI; NTIS (US Sales Only); INIS.

The Heterogenous Unix Monte Carlo Production Facility (HUMPF) simplifies the running of particle physics simulation programs on Unix workstations. Monte Carlo is the largest consumer of IBM (CPU) capacity within the Atlas centre at Rutherford Appleton Laboratory (RAL). It is likely that the future computing requirements of the LEP and HERA experiments cannot be satisfied by the IBM 3090 system. HUMPF adds extra capacity, and can be expanded with minimal effort. Monte Carlo programs are CPU-bound, and make little use of the vector or the input/output capacity of the IBM 3090. Such programs are therefore excellent candidates to use the spare capacity of powerful workstations. The main data storage is still handled centrally by the IBM 3090 and its peripherals. The HUMPF facility is suitable for any program with a similar profile. (author).

25420 (SAND–91-2016C) **Massively parallel multifrontal methods for finite element analysis on MIMD computer systems.** Benner, R.E. Sandia National Labs., Albuquerque, NM (United States). [1993]. 18p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-9306145–1: 8. international conference on vehicle structural mechanics and computer-aided engineering, Traverse City, MI (United States), 3-5 Jun 1993). Order Number DE93009838. Source: OSTI; NTIS; GPO Dep.

The development of highly parallel direct solvers for large, sparse linear systems of equations (e.g. for finite element or finite difference models) is lagging behind progress in parallel direct solvers for dense matrices and iterative methods for sparse matrices. We describe a massively parallel (MP) multifrontal solver for the direct solution of large sparse linear systems, such as those routinely encountered in finite element structural analysis, in an effort to address concerns about the viability of scalable, MP direct methods for sparse systems and enhance the software base for MP applications. Performance results are presented and future directions are outlined for research and development efforts in parallel multifrontal and related solvers. In particular, parallel efficiencies of 2511/o on 1024 NCUBE 2 nodes and 36% on 64 Intel iPSCS60 nodes have been demonstrated, and parallel efficiencies of 60–85% are expected when a severe load imbalance is overcome by static mapping and dynamic load balance techniques previously developed for other parallel solvers and application codes.

25421 (SAND–92-1724C) **The d-edge shortest-path problem for a Monge graph.** Bein, W.W. (New Mexico Univ., Albuquerque, NM (United States). Dept. of Computer Science); Larmore, L.L.; Park, J.K. Sandia National Labs., Albuquerque, NM (United States). 14 Jul 1992. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-930194–1: 4. annual ACM-SIAM conference on discrete algorithms, Austin, TX (United States), 25-27 Jan 1993). Order Number DE93009828. Source: OSTI; NTIS; GPO Dep.

A complete edge-weighted directed graph on vertices 1,2,...,n that assigns cost c(i,j) to the edge (i,j) is called Monge if its edge costs form a Monge array, i.e., for all $i < k$ and $j < l$, $c[i, j]+c[k,l] \leq c[i,l]+c[k,j]$. One reason Monge graphs are interesting is that shortest paths can be computed quite quickly in such graphs. In particular, Wilber showed that the shortest path from vertex 1 to vertex n of a Monge graph can be computed in O(n) time, and Aggarwal, Klawe, Moran, Shor, and Wilber showed that the shortest d-edge 1-to-n path (i.e., the shortest path among all 1-to-n paths with exactly d edges) can be computed in O(dn) time. This paper's contribution is a new algorithm for the latter problem. Assuming $0 \leq c[i,j] \leq U$ and $c[i,j + 1] + c[i + 1,j] - c[i,j] - c[i + 1, j + 1] \geq L > 0$ for all i and j, our algorithm runs in $O(n(1 + 1g(U/L)))$ time. Thus, when $d \gg 1 + 1g(U/L)$, our algorithm represents a significant improvement over Aggarwal et al.'s O(dn)-time algorithm. We also present several applications of our algorithm; they include length-limited Huffman coding, finding the maximum-perimeter d-gon inscribed in a given convex n-gon, and a digital-signal-compression problem.

25422 (SAND–92-2585C) **Finding minimum-quotient cuts in planar graphs.** Park, J.K.; Phillips, C.A. Sandia National Labs., Albuquerque, NM (United States). 18 Nov 1992. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-9305153–3: Association for Computing Machinery (ACM) symposium on the theory of computing, San Diego, CA (United States), May 1993). Order Number DE93011675. Source: OSTI; NTIS; GPO Dep.

Given a graph $G = (V, E)$ where each vertex $v \in V$ is assigned a weight w(v) and each edge $e \in E$ is assigned a cost c(e), the quotient of a cut partitioning the vertices of V into sets S and $\bar{S}$ is $c(S, \bar{S})/\min\{w(S), w(S)\}$, where $c(S, \bar{S})$ is the sum of the costs of the edges crossing the cut and w(S) and $w(\bar{S})$ are the sum of the weights of the vertices in S and $\bar{S}$, respectively. The problem of finding a cut whose quotient is minimum for a graph has in recent years attracted considerable attention, due in large part to the work of Rao and Leighton and Rao. They have shown that an algorithm (exact or approximation) for the minimum-quotient-cut problem can be used to obtain an approximation algorithm for the more famous minimumb-balanced-cut problem, which requires finding a cut $(S,\bar{S})$ minimizing $c(S,\bar{S})$ subject to the constraint $bW \leq w(S) \leq (1 - b)W$, where W is the total vertex weight and b is some fixed balance in the range $0 < b \leq \frac{1}{2}$. Unfortunately, the minimum-quotient-cut problem is strongly NP-hard for general graphs, and the best polynomial-time approximation algorithm known for the general problem guarantees only a cut whose quotient is at mostO(lg n) times optimal, where n is the size of the graph. However, for planar graphs, the minimum-quotient-cut problem appears more tractable, as Rao has developed several efficient approximation algorithms for the planar version of the problem capable of finding a cut whose quotient is at most some constant times optimal. In this paper, we improve Rao's algorithms, both in terms of accuracy and speed. As our first result, we present two pseudopolynomial-time exact algorithms for the planar minimum-quotient-cut problem. As Rao's most accurate approximation algorithm for the problem – also a pseudopolynomial-time algorithm – guarantees only a 1.5-times-optimal cut, our algorithms represent a significant advance.

25423 (SAND–93-0044C) **VFGEN: A parallel volume fraction generator for hydrocodes.** Ames, A.L.; Robinson, A.C.; Edwards, T.L. Sandia National Labs., Albuquerque, NM (United States). [1993]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-9304114–3: Object-oriented numerics conference, Sunriver, OR (United States), 25-27 Apr 1993). Order Number DE93011673. Source: OSTI; NTIS; GPO Dep.

Mesh generation for hypervelocity impact calculations involves computing the portion of the volume of each cell in a grid filled by a solid object. We have developed a volume fraction generator that supports three-dimensional regular Cartesian grids. It executes on both serial and massively parallel computers, and uses a commercial solid modeler (ACIS) to accurately compute the volume fractions. The volume fraction generator, VFGEN, was developed using an object-oriented paradigm facilitated by the ACIS C++ solid modeler toolkit. Although the underlying problem is embarrassingly parallel, a number of geometric optimizations have been developed to improve speed on serial architectures. The relationship of these optimizations to performance of the algorithm on parallel machines is described.

25424 (SAND–93-0050C) **MatResLib: A reusable, object-oriented material response library.** Wong, M.K.W.; Fang, H.E. Sandia National Labs., Albuquerque, NM (United States). [1993]. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-9304114–2: Object-oriented numerics conference, Sunriver, OR (United States), 25-27 Apr 1993). Order Number DE93011553. Source: OSTI; NTIS; GPO Dep.

Large-scale simulations of solid dynamics problems often require sophisticated models for reproducing material response. The developer of computational mechanics codes is faced with the task of programming the necessary material response algorithms, and also of ensuring that the available system capabilities are properly utilized to obtain the highest possible performance. Often a number of different programs need the same material models. Also, these programs are expected to perform efficiently on a wide variety of platforms. Thus, developing and maintaining a library of material models becomes difficult and time-consuming. In this paper, we describe a set of reusable libraries, written in C++[1], that seeks to minimize these difficulties. These libraries are collectively named MatResLib (for Material Response Library). We have pursued code reusability from four aspects. First, the implementation of new material models is facilitated by reusing code which defines an abstract base class for the type of model being implemented. This approach uses the inheritance mechanism of C++. Second, the library has been designed for reuse of the source code on different computing platforms, including the IBM PC, UNIX workstations, the CRAY-YWP, and the nCUBE 2, Intel/860, and Intel Paragon massively parallel computers. Third, the source code files are reusable among different continuum codes. Fourth, individual model classes are being reused in combination to develop more complex models.

25425 (SAND–93-0224) **An account of Sandia's research booth at Supercomputing '92: A collaborative effort in high-performance computing and networking.** Breckenridge, A.; Vahle, M.O. Sandia National Labs., Albuquerque, NM (United States). Mar 1993. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. Order Number DE93012397. Source: OSTI; NTIS; GPO Dep.

Supercomputing '92, a high-performance computing and communications conference was held, November 16–20, 1992 in Minneapolis, Minnesota. This paper documents the applications and technologies that were showcased in Sandia's research booth at that conference. In particular the demonstrations in high-performance networking, audio-visual applications in engineering, virtual reality, and supercomputing applications are all described.

25426 (SAND–93-0689C) **Tree reconstruction from partial orders.** Kannan, S.K. (Arizona Univ., Tucson, AZ (United States)); Warnow, T.J. Sandia National Labs., Albuquerque, NM (United States). [1993]. 11p. Sponsored by USDOE, Washington, DC (United States); National Science Foundation, Washington, DC (United States). DOE Contract AC04-76DP00789. Grant CCR 91-08969;Grant IRI 89-02813. (CONF-930884–1: Workshop on algorithms and data structures; International congress on automata and language processing, Montreal (Canada); Lund (Sweden), 11-13 Aug 1993; jul 1993; CONF-930770–1). Order Number DE93009841. Source: OSTI; NTIS; GPO Dep.

The problem of constructing trees given a matrix of interleaf distances is motivated by applications in computational evolutionary biology and linguistics. The general problem is to find an edge-weighted tree which most closely approximates the distance matrix. Although the construction problem is easy when the tree exactly fits the distance matrix, optimization problems under all popular criteria are either known or conjectured to be NP-complete. In this paper we consider the related problem where we are given a partial order on the pairwise distances, and wish to construct (if possible) an edge-weighted tree realizing the partial order. In particular we are interested in partial orders which arise from experiments on triples of species, which determine either a linear ordering of the three pairwise distances (called Total Order Model or TOM experiments) or only the pair(s) of minimum distance apart (called Partial Order Model or POM experiments). The POM and TOM experimental model is inspired by the model proposed by Kannan, Lawler, and Warnow for constructing trees from experiments which determine the rooted topology for any triple of species. We examine issues of construction of trees and consistency of TOM and POM experiments, where the trees may either be weighted or unweighted. Using these experiments to construct unweighted trees without nodes of degree two is motivated by a similar problem studied by Winkler, called the Discrete Metric Realization problem, which he showed to be strongly NP-hard. We have the following results: Determining consistency of a set of TOM or POM experiments is NP-Complete whether the tree is weighted or constrained to be unweighted and without degree two nodes. We can construct unweighted trees without degree two nodes from TOM experiments in optimal $O(n^3)$ time and from POM experiments in $O(n^4)$ time.

25427 (SAND–93-0690C) **Finding a covering triangulation whose maximum angle is provably small.** Mitchell, S.A.; Park, J.K. Sandia National Labs., Albuquerque, NM (United States). 3 Mar 1993. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-930884–2: Workshop on algorithms and data structures, Montreal (Canada), 11-13 Aug 1993). Order Number DE93010691. Source: OSTI; NTIS; GPO Dep.

Given a planar straight-line graph, we find a covering triangulation whose maximum angle is as small as possible. A covering triangulation is a triangulation whose vertex set contains the input vertex set and whose edge set contains the input edge set. Such a triangulation differs from the usual Steiner triangulation in that we may not add a Steiner vertex on any input edge. Covering triangulations provide a convenient method for triangulating multiple regions sharing a common boundary, as each region can be triangulated independently. As it is possible that no finite covering triangulation is optimal in terms of its maximum angle, we propose an approximation algorithm. Our algorithm produces a covering triangulation whose maximum angle γ is probably close to γ_{opt}, a lower bound on the maximum angle in any covering triangulation of the input graph. Note that we must have $\gamma \leq 3\gamma_{opt}$, since we always have $\gamma_{opt} \geq \pi/3$ and no triangulation can contain an angle of size greater than π. We prove something significantly stronger. We show that $\pi - \gamma \geq (\pi - \gamma_{opt})/6$, i.e., our γ is not much closer to π than is γ_{opt}. This result represents the first nontrivial bound on a covering triangulation's maximum angle. We require a subroutine for the following problem: Given a polygon with holes, find a Steiner triangulation whose maximum angle is bounded away from π. No angle larger than $8\pi/9$ is sufficient for the bound on γ claimed above. The number of Steiner vertices added by our algorithm and its running time are highly dependent on the corresponding bounds for the subroutine. Given an n-vertex planar straight-line graph, we require $O(n + S(n))$ Steiner vertices and $O(n \log n + T(n))$ time, where $S(n)$ is the number of Steiner vertices added by the subroutine and $T(n)$ is its running time for an $O(n)$-vertex polygon with holes.

25428 (SAND–93-0742C) **UNICOS® security testing.** Vandevender, W.H. Sandia National Labs., Albuquerque, NM (United States). [1993]. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-9305151–2: 15. computer security group training conference: mission possible - connected and protected, Albuquerque, NM (United States), 3-6 May 1993). Order Number DE93011680. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Developing security plans and supporting security tests is a very important part of the Department of Energy accreditation process. This paper will discuss the general testing methodology that was used to achieve DOE accreditation of the Secure UNICOS environment at Sandia National Laboratories (NM). In addition, some specific security testing procedures, tests and problem areas will be described.

25429 (SAND–93-0767C) **Development of generic field classes for finite element and finite difference problems.** Verner, D.A. (New Mexico Univ., Albuquerque, NM (United States). Dept. of Electrical and Computer Engineering); Heileman, G.L.; Budge, K.G.; Robinson, A.C. Sandia National Labs., Albuquerque, NM (United States). [1993]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789.

(CONF-9304114–4: Object-oriented numerics conference, Sunriver, OR (United States), 25-27 Apr 1993). Order Number DE93011678. Source: OSTI; NTIS; GPO Dep.

This paper considers the development of a reusable object-oriented array library, as well as the use of this library in the construction of finite difference and finite element codes. The classes in this array library are also generic enough to be used to construct other classes specific to finite difference and finite element methods. The authors demonstrate the usefulness of this library by inserting it into two existing object-oriented scientific codes developed at Sandia National Laboratories. One of these codes is based on finite difference methods, while the other is based on finite element methods. Previously, these codes were separately maintained across a variety of sequential and parallel computing platforms. The use of object-oriented programming allows both codes to make use of common base classes. This offers a number of advantages related to optimization and portability. Optimization efforts, particularly important in large scientific codes, can be focused on a single library. Furthermore, by encapsulating machine dependencies within this library, the optimization of both codes on different architectures will only involve modification to a single library.

25430 (SAND–93-0908C) **Kerberos a UNIX–TCP/IP network authentication system.** Rahe, W.H.; Machin, G.D. Sandia National Labs., Albuquerque, NM (United States). [1993]. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-9305151–5: 15. computer security group training conference: mission possible - connected and protected, Albuquerque, NM (United States), 3-6 May 1993). Order Number DE93011677. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Vulnerabilities inherent in network transmissions reduce the security protections provided by multiple remote authentication processes. The "trusted systems' concept also provides potential for inadvertent or deliberate abuse of computing resources. Additionally, since the owner of a workstation potentially has complete control of a particular workstation, including the ability to edit all files and add customer accounts through the use of privileged accounts, additional security concerns exist including file integrity, file privacy, and customer masquerade. for remote access and remote file storage. In a networked computing environment, both the customer/client and the server identities become more difficult to assure. The possibility of disclosure and non-assurance of information integrity transmitted on the network media are markedly increased In recognition of these difficulties, (DEC) International Business Machines (IBM) provided funding for the creation of Project Athena at (MIT) whose charter was to address distributed computing including security. Kerberos is an application developed by this project to provide centralized "third-party" authentication in a distributed network. Network access control may be provided by Kerberos for each of the computing resources within either a local or remote network. Kerberos contains a database of principals and encryption keys in a Key Distribution Center (KDC). The KDC contains the keys (passwords) or all customers and must reside on a tightly controlled, limited access system. The KDC provides non-corruptible authentication credentials which are used in conjunction with the local authorization file and local services to perform the authentication and authorization functions for local and remote customer requests.

25431 (SAND–93-0955) **Bringing theory to practice: The reality of interprocessor communication.** Greenberg, D.S.; McCurley, K.S. Sandia National Labs., Albuquerque, NM (United States). [1993]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-9304140–1: Workshop on analyzing scalibility of parallel algorithms, Newport Beach, CA (United States), 13 Apr 1993). Order Number DE93012346. Source: OSTI; NTIS; GPO Dep.

Determining the best topology for the interconnection network of a scalable processor is not possible via theoretical models. However, we might hope that theoretical results would at least help researchers to make the most efficient use possible of existing machines. Unfortunately theoretical work often stops short of providing everything which the practitioner requires. In this paper two communication problems broadcast, are used to illustrate the additional effort required to make the theoretical practical.

25432 (SAND–93-0956C) **Beyond core: Making parallel computer I/O practical.** Womble, D. (Sandia National Labs., Albuquerque, NM (United States)); Greenberg, D.; Wheat, S.; Riesen, R. Sandia National Labs., Albuquerque, NM (United States). [1993]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-9306157–1: Parallel I/O and databases symposium, Hanover, NH (United States), 21-30 Jun 1993). Order Number DE93012347. Source: OSTI; NTIS; GPO Dep.

The solution of Grand Challenge Problems will require computations which are too large to fit in the memories of even the largest machines. Inevitably new designs of I/O systems will be necessary to support them. Through our implementations of an out-of-core LU factorization we have learned several important lessons about what I/O systems should be like. In particular we believe that the I/O system must provide the programmer with the ability to explicitly manage storage. One method of doing so is to have a partitioned secondary storage in which each processor owns a logical disk. Along with operating system enhancements which allow overheads such as buffer copying to be avoided, this sort of I/O system meets the needs of high performance computing.

25433 (SLAC-PUB–5895) **Optimal routing of IP packets to multi-homed servers.** Swartz, K.L. Stanford Linear Accelerator Center, Menlo Park, CA (United States). Aug 1992. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00515. (CONF-9210331–2: 6. Usenix Systems Administration conference on large installation system administration, Long Beach, CA (United States), 19-23 Oct 1992). Order Number DE93010949. Source: OSTI; NTIS; INIS; GPO Dep.

Multi-homing, or direct attachment to multiple networks, offers both performance and availability benefits for important servers on busy networks. Exploiting these benefits to their fullest requires a modicum of routing knowledge in the clients. Careful policy control must also be reflected in the routing used within the network to make best use of specialized and often scarce resources. While relatively straightforward in theory, this problem becomes much more difficult to solve in a real network containing often intractable implementations from a variety of vendors. This paper presents an analysis of the problem and proposes a useful solution for a typical campus network. Application of this solution at the Stanford Linear Accelerator Center is studied and the problems and pitfalls encountered are discussed, as are the workarounds used to make the system work in the real world.

25434 (UCRL-ID–113953) **Comments on computational underwater acoustics.** Hedstrom, G. Lawrence Livermore National Lab., CA (United States). Apr 1993. 6p. Sponsored by USDOE, Washington, DC (United States); Department of Defense, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE93013789. Source: OSTI; NTIS; GPO Dep.

Two fundamental facts control the choice of computational methods in underwater acoustics. One is that over most of the ocean the sound speed varies much more rapidly with depth than in the horizontal directions. The other is that upon going down from the surface, the sound speed usually decreases to a minimum and then increases from there to the bottom. These properties of the medium imply that the ocean often acts as a waveguide, with energy trapped in a depth-band about the sound-speed minimum. One consequence of these facts is that approximation by normal modes is valid over large regions of the ocean, particularly if correction is made for the slow variation of the modes caused by variation in bottom depth and horizontal variation in sound speed. In portions of the ocean where approximation by normal modes is not valid, we may still often use a paraxial approximation. Paraxial approximations may be used when the wave motion is primarily in a single direction, with slow variation of the signal in directions tangent to the wave front. They are often called "parabolic" equations in ocean acoustics, but the term "paraxial" is standard in other branches of physics, inducting optics and seismology. Finite-difference approximations are also sometimes used in underwater acoustics, but they are much more computationally intensive than

normal modes or paraxial approximations. Finite differences are therefore ordinarily used only where these other methods are not valid, such as in shallow water with rapidly varying depth. One could also use finite elements in these instances, but for acoustics problems finite elements are a special class of finite-difference methods. We discuss finite differences only briefly in this report, because they are not generally used in long-range acoustics.

25435 (UCRL-JC–111212) **PC viruses: How do they do that?.** Pichnarczyk, K. Lawrence Livermore National Lab., CA (United States). Jul 1992. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9208108–2: Workshop on computer security incident handling, Denver, CO (United States), Aug 1992). Order Number DE93012581. Source: OSTI; NTIS; GPO Dep.

The topic of PC Viruses has been an issue for a number of years now. They've been reported in every major newspaper, tabloids, television and radio. People from all fields get viruses: government, private sector businesses, home computers, schools, computer software suppliers. A definition is proposed to introduce the virus phenomenon. Virus authors come from a variety of communities. Motives and ideologies of authors are discussed, and examples of viruses are offered. Also mentioned is the growing number of viruses developed, isolated, and never distributed to the public at large, but kept within the antivirus research community. Virus examples are offered as well. Viruses are distributed not only through bulletin boards and shareware, but also from areas previously assumed to be safe, including the threat of receiving a virus through a standard in-house function, such as an in-house hardware maintenance shop. Three categories of viruses are presented: File Infecter viruses, Boot Sector Infecters, and the new category of Directory Entry Infecter virus. Also discussed are crossover viruses, that is, viruses which utilize a variety of techniques to ensure survival. An explanation of what is occurring within every stage of various viruses is given. Replication strategies common to all three types is noted, mainly the two different replication strategies of memory resident infecters and active selection infecters. A detailed definition, description and application of a stealth virus is presented. Detection strategies are discussed as each topic in this section is completed; a high level schemata of the operation of various virus detection programs ispresented. Since most eradication today is done using virus detection/eradication software, this paper attempts to reveal the techniques used by these packages.Included in the paper is the topic of manual eradication.

25436 (UCRL-JC–111224) **Generalized smooth models.** Glosup, J. Lawrence Livermore National Lab., CA (United States). 23 Jul 1992. 17p. Sponsored by USDOE, Washington, DC (United States); National Science Foundation, Washington, DC (United States). DOE Contract W-7405-ENG-48. Grant DMS 8802722. (CONF-920893–7: Joint statistical meetings of the American Statistical Association, the Biometric Society and the Institute of Mathematical Statistics, Boston, MA (United States), 9-13 Aug 1992). Order Number DE93013045. Source: OSTI; NTIS; GPO Dep.

The class of gene linear models is extended to develop a class of nonparametric regression models known as generalized smooth models. The technique of local scoring is used to estimate a generalized smooth model and the estimation procedure based on locally weighted regression is shown to produce local likelihood estimates. The asymptotically correct distribution of the deviance difference is derived and its use in comparing the fits of generalized linear models and generalized smooth models is illustrated. The relationship between generalized smooth models and generalized additive models is discussed, also.

25437 (UCRL-JC–111227) **Some aspects of sheet forming simulation using explicit finite element techniques.** Whirley, R.G.; Engelmann, B.E.; Logan, R.W. Lawrence Livermore National Lab., CA (United States). 28 Jul 1992. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-921110–49: Winter annual meeting of the American Society of Mechanical Engineers (ASME), Anaheim, CA (United States), 8-13 Nov 1992). Order Number DE93012479. Source: OSTI; NTIS; GPO Dep.

This paper discusses some aspects of the application of the explicit nonlinear finite element code DYNA3D to the numerical simulation of sheet forming processes. Although DYNA3D is intrinisically a code for transient dynamic response, it has been successfully applied to the quasistatic sheet forming problem by slow application of the loads. Although somewhat nontraditional, this approach has proven very robust in application to large-scale problems. This paper discusses the components of a successful sheet forming analysis, including constitutive modeling, contact definition, guidelines for load application, and some suggestions for solution evaluation. Further, this paper illustrates the use of DYNA3D to compute the Limiting Draw Ratio as a function of material anisotropy and compares the computed results for 3-D forming problems with experimental data.

25438 (UCRL-JC–111883) **Uniform user and group IDs on a large network.** Crispin, K. Lawrence Livermore National Lab., CA (United States). Oct 1992. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9210353–1: CRAY User Group meeting, Washington, DC (United States), 9-13 Oct 1992). Order Number DE93013047. Source: OSTI; NTIS; GPO Dep.

Over the past few years the Livermore Computer Center has converted from a "home grown system" facility to a more or less standard UNIX environment. As a result we have several hundred UNIX on our network ranging from the UNICOS Crays to Sun workstations. For the usual reasons we want to maintain a single UID space across all these systems. This paper describes some of the problems and issues we have encountered in pursuit of this goal.

25439 (UCRL-JC–111956) **Deconvolution for positive signals.** Goodman, D.M. Lawrence Livermore National Lab., CA (United States). Oct 1992. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9206371–1: Symposium on fundamentals of discrete time systems, Chicago, IL (United States), 26-27 Jun 1992). Order Number DE93013044. Source: OSTI; NTIS; GPO Dep.

We consider estimating an unknown positive signal from an observed signal that has been corrupted by known linear dynamics and additive noise. In many experiments the goal is to estimate energy or power as a function of time; consequently, the positive deconvolution problem occurs frequently in a wide variety of scientific disciplines. We present two new methods. One is based on Mallows' C_L statistic, and the other is based on conjugate gradients. We describe several other methods. This paper considers "small sample" problems. This fact and the imposition of positivity constrants makes analytic comparisons of the methods impossible. Therefore, we include preliminary Monte-Carlo comparisons.

25440 (UCRL-JC–112015) **Connecting UNICOS data migration to a UniTree storage system.** Hamilton, P.; Minton, J. Lawrence Livermore National Lab., CA (United States). Oct 1992. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9209204–5: Cray users group meeting, Washington, DC (United States), 14-18 Sep 1992). Order Number DE93012576. Source: OSTI; NTIS; GPO Dep.

Files are produced much faster than they are destroyed on supercomputer file systems. Data migration is one solution to the "disk full" problem. A data migration system is described that connects a UNICOS file system to a UniTree storage system.

25441 (UCRL-JC–112016) **The PVM systems: An in-depth analysis and documenting study – Concise edition.** Grant, B.K.; Skjellum, A. Lawrence Livermore National Lab., CA (United States). Nov 1992. 20p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-930773–1: 9. international conference on systems engineering (ICSE '93), Las Vegas, NV (United States), 14-16 Jul 1993). Order Number DE93011959. Source: OSTI; NTIS; GPO Dep.

PVM (Parallel Virtual Machine) is a basic message-passing system for heterogeneous collections of networked computers, developed at Oak Ridge National Laboratory, University of Tennessee and Emory University. This report is our "third-party" effort to answer most common questions about PVM, and to dispel many misconceptions regarding its capabilities. We strive to present an accurate assessment of the system, while adding our own opinions

regarding the system, and offering a few suggestions for the future of the system. PVM version 2.4-1, the latest version at the time of the writing of this report, is summarized within this document; our forthcoming full report includes significantly more detailed information. Information on how to get the full report is included.

25442 (UCRL-JC–112022) **The Zipcode message-passing system.** Skjellum, A. (Lawrence Livermore National Lab., CA (United States)); Smith, S.G.; Still, C.H.; Leung, A.P.; Morari, M. Lawrence Livermore National Lab., CA (United States). 12 Nov 1992. 18p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-930331–9: 6. Society for Industrial and Applied Mathematics (SIAM) conference on parallel processing for scientific computing, Norfolk, VA (United States), 21-24 Mar 1993). Order Number DE93011958. Source: OSTI; NTIS; GPO Dep.

Zipcode is a message-passing system developed originally by the first author, beginning at Caltech in the Summer of 1988 and continuing to-date absent in then-existing message-passing systems. Currently, Zipcode continues to serve as a vehicle to demonstrate high-level message-passing research concepts and, more importantly, to provide the basis for supporting vendor-independent scalable concurrent libraries; notably, the Multicomputer Toolbox. The basic assertion of Zipcode is that carefully managed, expressive message-passing is an effective way to program multicomputers and distributed computers, while low-level message passing is admittedly both error-prone and difficult. The purpose of Zipcode is to manage the message-passing process within parallel codes in an open-ended way. This is done so that large-scale software can be constructed in a multicomputer application, with reduced likelihood that software so constructed will conflict in its dynamic resource use, thereby avoiding potentially hard-to-resolve, source-level conflicts. Furthermore, the message-passing-notations provided are to reflect the algorithms and data organizations of the concurrent algorithms, rather than predefined typing strategies. Typing, while generic and easy-to-understand, proves too low-level to support manageable application development well. Notational abstractions provide a means for the user to incorporate information through which the Zipcode library may make optimizations when a code runs on systems with specific hardware features. Abstraction is therefore seen as a means to higher performance, and notation is seen as a means towards more understandable, easier-to-develop and maintain concurrent software. Context registry provides a "social contract" within which multiple libraries and codes can coexist reasonably.

25443 (UCRL-JC–112301) **Practical authorization in large heterogeneous distributed systems.** Fletcher, J.G.; Nessett, D.M. Lawrence Livermore National Lab., CA (United States). Nov 1992. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-930245–1: Privacy and Security Research Group workshop on network and distributed systems security, San Diego, CA (United States), 11-12 Feb 1993). Order Number DE93013192. Source: OSTI; NTIS; INIS; GPO Dep.

Requirements for access control, especially authorization, in practical computing environments are listed and discussed. These are used as the basis for a critique of existing access control mechanisms, which are found to present difficulties. A new mechanism, fire of many of these difficulties, is then described and critiqued.

25444 (UCRL-JC–112597) **Optimal hemicube sampling.** Max, N. (Lawrence Livermore National Lab., CA (United States)). Lawrence Livermore National Lab., CA (United States). 17 Dec 1992. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-930881–1: Siggraph '93 conference, Anaheim, CA (United States), 2-6 Aug 1993). Order Number DE93010499. Source: OSTI; NTIS; GPO Dep.

Radiosity algorithms for global illumination, either "gathering" or "shooting" versions, depend on the calculation of form factors. It is possible to calculate the form factors analytically, but this is difficult when occlusion is involved, so sampling methods are usually preferred. The necessary visibility information can be obtained by ray tracing in the sampled directions. However, area coherence makes it more efficient to project and scan-convert the scene onto a number of planes, for example, the faces of a hemicube. The hemicube faces have traditionally been divided into equal square pixels, but more general subdivisions are practical, and can reduce the variance of the form factor estimates. The hemicube estimates of form factors are based on a finite set of sample directions. We obtain several optimal arrangements of sample directions, which minimize the variance of this estimate. Four approaches are changing the size of the pixels, the shape of the pixels, the shape of the hemicube, or using non-uniform pixel grids. The best approach reduces the variance by 43%. The variance calculation is based on the assumption that the errors in the estimate are caused by the projections of single edges of polygonal patches, and that the positions and orientations of these edges are random.

25445 (UCRL-JC–112601) **Smooth transitions between bump rendering algorithms.** Becker, B.G. Max, N.L. (California Univ., Davis, CA (United States)). Lawrence Livermore National Lab., CA (United States). 4 Jan 1993. 37p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-930881–2: Siggraph '93 conference, Anaheim, CA (United States), 2-6 Aug 1993). Order Number DE93012504. Source: OSTI; NTIS; GPO Dep.

A method is described for switching smoothly between rendering algorithms as required by the amount of visible surface detail. The result will be more realism with less computation for displaying objects whose surface detail can be described by one or more bump maps. The three rendering algorithms considered are bidirectional reflection distribution function (BRDF), bump-mapping, and displacement-mapping. The bump-mapping has been modified to make it consistent with the other two. For a given viewpoint, one of these algorithms will show a better trade-off between quality, computation time, and aliasing than the other two. Thus, it needs to be determined for any given viewpoint which regions of the object(s) will be rendered with each algorithm The decision as to which algorithm is appropriate is a function of distance, viewing angle, and the frequency of bumps in the bump map.

25446 (UCRL-JC–112806) **Virtual sound for virtual reality.** Blattner, M.M. (Anderson (M.D.) Cancer Center, Houston, TX (United States). Dept. of Biomathematics); Papp, A.L. III. Lawrence Livermore National Lab., CA (United States); California Univ., Davis, CA (United States). Feb 1993. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9303127–1: Virtual reality system '93, New York, NY (United States), 15-17 Mar 1993). Order Number DE93010519. Source: OSTI; NTIS; GPO Dep.

The computational limitations of real-time interactive computing do not meet our requirements for producing realistic images for virtual reality in a convincing manner. Regardless of the real-time restrictions on virtual reality interfaces, the representations can be no better than the graphics. Computer graphics is still limited in its ability to generate complex objects such as landscapes and humans. Nevertheless, useful and convincing visualizations are made through a variety of techniques. The central theme of this article is that a similar situation is true with sound for virtual reality. It is beyond our abilityto create interactive soundscapes that create a faithful reproduction of real world sounds, however, by choosing one's application carefully and using sound to enhance a display rather than only mimic real-world scenes, a very effective use of sound can be made.

25447 (UCRL-JC–112808) **Simplified quantitative treatment of uncertainty and interindividual variability in health risk assessment.** Bogen, K.T. Lawrence Livermore National Lab., CA (United States). Jan 1993. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE93010520. Source: OSTI; NTIS; INIS; GPO Dep.

A distinction between uncertainty (or the extent of lack of knowledge) and interindividual variability (or the extent of person-to-person heterogeneity) regarding the values of input variates must be maintained if a quantitative characterization of uncertainty in population risk or in individual risk is sought. Here, some practical methods are presented that should facilitate implementation of the analytic framework for uncertainty and variability proposed by Bogen and Spear. (1,2) Two types of methodology are discussed: one that facilitates the distinction between uncertainty and variability per se, and another that may be used to simplify quantitative

analysis of distributed inputs representing either uncertainty or variability. A simple and a complex form for modeled increased risk are presented and then used to illustrate methods facilitating the distinction between uncertainty and variability in reference to characterization of both population and individual risk. Finally, a simple form of discrete probability calculus is proposed as an easily implemented, practical alternative to Monte-Carlo based procedures to quantitative integration of uncertainty and variability in risk assessment.

25448 (UCRL-JC–113531) **Networks of real-time processes.** Yates, R.K. Lawrence Livermore National Lab., CA (United States). 8 Mar 1993. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-930898–1: 4. international conference on concurrency theory, Hildesheim (Germany), 23-26 Aug 1993). Order Number DE93013049. Source: OSTI; NTIS; GPO Dep.

Networks of real-time processes we prove that the input-output function computed by a network of asynchronous real-time processes is described by the unique fixed point of a network functional even though the components of the network may compute nonmonotonic functions. The techniques used are those of contractive functions on metric spaces rather than the usual Scott continuity on partial orders. Thus a well-known principle of Kahn is extended to an important model of parallel systems that has been resistant to the traditional approach using Scott continuity.

25449 (UCRL-MA–108965-Rev.1) **PML user's manual for PML Version 2.0: Revision 1.** Brown, S.A.; Braddy, D. Lawrence Livermore National Lab., CA (United States). 4 Jan 1993. 36p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE93013132. Source: OSTI; NTIS (documentation only); ESTSC (complete software package), P.O. Box 1020, Oak Ridge, TN 37831-1020; GPO Dep.

There are many mathematics libraries currently enjoying widespread use. At the time that PML was begun, however, there were very few written in C and fewer still written with portability in mind. The temptation has all too often been to program to a specific hardware platform and forget portability. More recently some very good work has been published by Press, Flannery, Teulkovsky, and Vetterling, Numerical Recipes in C, which is highly portable. No one library is apt to have everything that a given application needs and there are other considerations such as interfaces and related functionality to drive the development of a math library. The reason for writing PML hasn't changed in spite of this. PML (Portable Mathematics Library) was developed initially as a repository for any routines of a mathematical nature in what has become the PACT system. More recently, I have tried to systematize the library and organize it for future growth. The library has two fundamental parts. First are the many pure math routines such as equation solvers. Second are the structure definitions and some related functions. The structures which PML supports are provided to aid C programmers in organizing their mathematical computations in a mathematical way. That is, they are encouraged to give primary consideration to the mathematics not the implementation of the mathematics. This also is intended to add to the mathematical rigor of simulations and promote the use of some of the more abstract but critical ideas of mathematics by giving application developers concrete representations of abstract structures. The data structures for PML are presented first since they support most of the library. A summary of the mathematical functions comes next. A set of examples completes this manual.

25450 (UCRL-MA–108975) **PDBDiff user's manual.** Brown, S.A. Lawrence Livermore National Lab., CA (United States). 7 Jan 1992. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE93013200. Source: OSTI; NTIS (documentation only); ESTSC (complete software package), P.O. Box 1020, Oak Ridge, TN 37831-1020; GPO Dep.

The SABrE system provides a number of tools for working with PDB files in a fairly generic fashion. In particular, PDBDiff compares the contents of two PDB files and displays the differences (in a manner similar but not identical to the UNIX utility diff). PDBDiff can also be run in an interactive mode which lets a user compare two PDB files on an item by item basis. The PDB tools, PDBView, PDBLS, PDBDiff, and PDBComp, are all SX programs. SX is a dialect of the LISP programming language which consists of extensions to the SCHEME dialect of LISP. The extensions provide functionality for graphics, binary data handling, and other areas of functionality. PDBDiff has a "help" command which lists its commands.

25451 (UCRL-MA–108976) **SCORE user's manual.** Brown, S.A. Lawrence Livermore National Lab., CA (United States). 7 Jan 1992. 28p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE93013091. Source: OSTI; NTIS; GPO Dep.

SABrE is a set of tools to facilitate the development of portable scientific software and to visualize scientific data. As with most constructs, SABRE has a foundation. In this case that foundation is SCORE. SCORE (SABRE CORE) has two main functions. The first and perhaps most important is to smooth over the differences between different C implementations and define the parameters which drive most of the conditional compilations in the rest of SABRE. Secondly, it contains several groups of functionality that are used extensively throughout SABRE. Although C is highly standardized now, that has not always been the case. Roughly speaking C compilers fall into three categories: ANSI standard; derivative of the Portable C Compiler (Kernighan and Ritchie); and the rest. SABRE has been successfully ported to many ANSI and PCC systems. It has never been successfully ported to a system in the last category. The reason is mainly that the "standard" C library supplied with such implementations is so far from true ANSI or PCC standard that SABRE would have to include its own version of the standard C library in order to work at all. Even with standardized compilers life is not dead simple. The ANSI standard leaves several crucial points ambiguous as "implementation defined." Under these conditions one can find significant differences in going from one ANSI standard compiler to another. SCORE's job is to include the requisite standard headers and ensure that certain key standard library functions exist and function correctly (there are bugs in the standard library functions supplied with some compilers) so that, to applications which include the SCORE header(s) and load with SCORE, all C implementations look the same.

25452 (UCRL-MA–111145) **Fortran graphics routines for the Macintosh.** Shore, B.W. Lawrence Livermore National Lab., CA (United States). Jun 1992. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE93013092. Source: OSTI; NTIS; GPO Dep.

The Language Systems MPW Fortran is a popular Fortran compiler for the Macintosh. Unfortunately, it does not have any built-in calls to graphics routines (such as are available with Graflib on the NLTSS), so there is no simple way to make x-y plots from calls within Fortran. Instead, a file of data must be created and a commercial plotting routine (such as IGOR or KALEIDAGRAPH) or a spreadsheet with graphics (such as WINGZ) must be applied to post-process the data. The Macintosh does have available many built-in calls (to the Macintosh Toolbox) that allow drawing shapes and lines with quickdraw, but these are not designed for plotting functions and are difficult to learn to use. This work outlines some Fortran routines that can be called from LS Fortran to make the necessary calls to the Macintosh toolbox to create simple two-dimensional plots or contour plots. The source code DEMOGRAF.F shows how these routines may be used. DEMOGRAF.F simply demonstrates some Fortran subroutines that can be called with language systems MPW Fortran on the Macintosh to plot arrays of numbers. The subroutines essentially mimic the functionality that has been available at LTSS and NLTSS and UNICOS at LLNL. The graphics primitives are kept in four separate files, each containing several subroutines. The subroutines are compiled and stored in a library file, LIBgraf.o. Makefile is used to link this library to the source code. A discussion is included on requirements for interactive plotting of functions.

25453 (UCRL-MA–112087) **PACT user's guide.** Brown, S.A.; Braddy, D. Lawrence Livermore National Lab., CA (United States). 4 Jan 1993. 26p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE93013093. Source: OSTI; NTIS; GPO Dep.

In a computing landscape which has many different hardware architectures and supporting software systems ranging from compilers to operating systems, there is an obvious and strong need for a philosophy of software development that lends itself to the design and construction of portable code systems. The current efforts to standardize software bear witness to this need. PACT is an effort to implement a software development environment which is itself portable and promotes the design and construction of portable applications. PACT does not include such important tools as editors and compilers. Well built tools of that kind are readily available across virtually all computer platforms. The areas that PACT addresses are at a higher level involving issues such as data portability, portable inter-process communication, and graphics. In its current conception, PACT is a set of 10 tools. Nine of these are implemented as libraries, and two of them provide both libraries and executable applications. PACT is entirely coded in C but was designed with a view toward support of other languages, notably FORTRAN.

9903 Information Handling

Refer also to citation(s) 22831, 22838, 23149, 23153, 23492, 23662, 23895, 23911, 24340, 24762, 24861, 24910, 24936, 25061, 25105, 25106, 25107, 25122, 25123, 25246, 25340

25454 (DPW–4461) **Trip report to Washington AEC to discuss document distribution: Trip report, January 11, 1952.** Andrews, J.C. Du Pont de Nemours (E.I.) and Co., Wilmington, DE (United States). 1952. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. (SR/H–461). Order Number DE93011156. Source: OSTI; NTIS (US Sales Only); GPO Dep.

On Friday January 11, 1952, a meeting was held in Washington, DC to discuss a new category "Technology-Savannah River" to be added to the standard distribution lists for the US AEC research and development reports and to discuss the distribution of du Pont reports within the framework of these lists. During this meeting, it was decided that the category "Technology-Savannah River" would be added to the standard distribution; du Pont (DP) reports would be circulated according to the US AEC standard distribution; DP reports would be included in the publication "Abstracts of Classified Reports"; the Technical Information Service (TIS) would be responsible for the reproduction and distribution of DP reports; and internal reports would not be distributed by TIS unless the Savannah River Operations Office had an official request for the report.

25455 (GSF–10/92) **Information system 'Environmentally hazardous materials'. Final report.** Voigt, K. (GSF - Forschungszentrum fuer Umwelt und Gesundheit GmbH, Neuherberg (Germany). Projektgruppe Umweltgefaehrdungspotentiale von Chemikalien (PVC)); Pepping, T. GSF - Forschungszentrum fuer Umwelt und Gesundheit GmbH, Neuherberg (Germany). Mar 1992. 122p. (In German). Order Number DE93792033. Source: OSTI; NTIS (US Sales Only).

A computer-assisted information system was developed which permits and optimizes access to data on environmentally hazardous materials. Data-basis were established on the basis of the available data sources. The information system was tested for the parameter 'Concentrations' (in water, soil, air, foodstaffs and drinking water) for 68 environmentally relevant substances. The communication software NPF-UIX (= Network Pass Through Facility) was developed for access to online databases. (BBR).

25456 (INDC(NDS)–202/GA, pp. 41-46) **The present status of A and M data research in China. The introduction of CRAAMD.** Du, X.W. (IAPCM, Beijing (China). Nuclear Data Committee of China); Zhou, E.C. International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Feb 1988. (CONF-8711366–: 7. meeting of the Atomic and Molecular Data Centre Network, Oak Ridge, TN (United States), 9-11 Nov 1987). In *7. meeting of the Atomic and Molecular Data Centre Network, Oak Ridge National Laboratory, Oak Ridge, TN, 9-11 November 1987: Summary report.* [54p.] Order Number DE93626599. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. ATOMIC PHYSICS/china; ATOMIC PHYSICS/information systems; ATOMIC PHYSICS/nuclear data collections; CHINA; CHARGE EXCHANGE; DATA BASE MANAGEMENT; ELECTRON-ATOM COLLISIONS; ELECTRON-MOLECULE COLLISIONS; IONIZATION; PROGRESS REPORT; RECOMBINATION

25457 (INDC(NDS)–204/GSp) **Report on the 9. IAEA consultants' meeting of the nuclear reaction data centres: Including the 20. four-centres meeting of the neutron data centers and the 10. meeting on charged particle nuclear data compilation.** Lemmel, H.D. (ed.). International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Apr 1988. [152p.] (CONF-871026–: IAEA Data Networking meeting, Upton, NY (United States), 26-30 Oct 1987). Order Number DE93626597. Source: OSTI; NTIS (US Sales Only); INIS.

This report summarizes the 1987 co-ordination meeting of the national and regional nuclear reaction data centers, convened by the IAEA at regular intervals. The main topics are: the international exchange of nuclear reaction data by means of the "EXFOR" system, and the further development of this system; the "CINDA" system as an international index and bibliography to neutron reaction data; the sharing of the workload for speedy and reliable data compilation; the exchange and documentation of evaluated data libraries in ENDF format, with the goal of rendering data center services to data users in IAEA Member States by means of computer retrievals and printed materials. (author). Refs, figs and tabs.

25458 (INDC(NDS)–204/GSp, pp. 59-87) **National Nuclear Data Center status report.** International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Apr 1988. (CONF-871026–: IAEA Data Networking meeting, Upton, NY (United States), 26-30 Oct 1987). In *Report on the 9. IAEA consultants' meeting of the nuclear reaction data centres: Including the 20. four-centres meeting of the neutron data centres and the 10. meeting on charged particle nuclear data compilation.* [152p.] Order Number DE93626597. Source: OSTI; NTIS (US Sales Only); INIS.

The report presents the activities of the US National Nuclear Data Center, Brookhaven National Laboratory, concerning the computer facilities, the published bibliographies, the data libraries, the evaluated nuclear reaction and nuclear structure data, customer service and other publications. Request statistics concerning the experimental neutron, charged particles and photonuclear data are included. 3 tabs.

25459 (INDC(NDS)–204/GSp, pp. 89-93) **NEA Data Bank progress report to the nuclear reaction data centres.** International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Apr 1988. (CONF-871026–: IAEA Data Networking meeting, Upton, NY (United States), 26-30 Oct 1987). In *Report on the 9. IAEA consultants' meeting of the nuclear reaction data centres: Including the 20. four-centres meeting of the neutron data centres and the 10. meeting on charged particle nuclear data compilation.* [152p.] Order Number DE93626597. Source: OSTI; NTIS (US Sales Only); INIS.

The report presents shortly the activities of the NEA Data Bank concerning neutron data compilation, the Joint Evaluated File, computer program services, validation of nuclear model codes, nuclear waste management and reactor safety.

25460 (INDC(NDS)–204/GSp, pp. 95-101) **NDS status report to the 1987 NRDC meeting.** Lemmel, H.D. (International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee). International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Apr 1988. (CONF-871026–: IAEA Data Networking meeting, Upton, NY (United States), 26-30 Oct 1987). In *Report on the 9. IAEA consultants' meeting of the nuclear reaction data centres: Including the 20. four-centres meeting of the neutron data centres and the 10. meeting on charged particle nuclear data compilation.* [152p.] Order Number DE93626597. Source: OSTI; NTIS (US Sales Only); INIS.

The report presents the activities of the IAEA Nuclear Data Section concerning CINDA, EXFOR system, data evaluation, publications, customer services, programming and systems development, on-line center-to-center data transmission.

25461 (INDC(NDS)–204/GSp, pp. 103-109) **The main results of the USSR neutron data activities in 1986-1987.** Manokhin, V.N. International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Apr 1988. (CONF-871026–: IAEA Data Networking meeting, Upton, NY (United States), 26-30 Oct 1987). In *Report on the 9. IAEA consultants' meeting of the nuclear reaction data centres: Including the 20. four-centres meeting of the neutron data centres and the 10. meeting on charged particle nuclear data compilation.* [152p.] Order Number DE93626597. Source: OSTI; NTIS (US Sales Only); INIS.

The report gives a review of the main results of neutron data activities in USSR and the activity of Nuclear Data Center in 1986-1987, namely concerning the experimental neutron data, the evaluated neutron data and the theoretical work.

25462 (INDC(NDS)–204/GSp, pp. 119-124) **Status report of RIKEN Nuclear Data Group.** International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Apr 1988. (CONF-871026–: IAEA Data Networking meeting, Upton, NY (United States), 26-30 Oct 1987). In *Report on the 9. IAEA consultants' meeting of the nuclear reaction data centres: Including the 20. four-centres meeting of the neutron data centres and the 10. meeting on charged particle nuclear data compilation.* [152p.] Order Number DE93626597. Source: OSTI; NTIS (US Sales Only); INIS.

The report presents the activities of the RIKEN Nuclear Data Group to collect the reaction cross sections useful for radioisotope production in nuclear medicine. 3 figs, 1 tab.

25463 (INDC(NDS)–204/GSp, pp. 125-142) **Nuclear data activities in China.** Cai Dunjiu (Chinese Nuclear Data Center, Beijing (China)); Shi Xiangjun; Yuan Hanrong. International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Apr 1988. (CONF-871026–: IAEA Data Networking meeting, Upton, NY (United States), 26-30 Oct 1987). In *Report on the 9. IAEA consultants' meeting of the nuclear reaction data centres: Including the 20. four-centres meeting of the neutron data centres and the 10. meeting on charged particle nuclear data compilation.* [152p.] Order Number DE93626597. Source: OSTI; NTIS (US Sales Only); INIS.

The report describes the organization and the objectives of nuclear data activities in China and the specific activities on nuclear data evaluation. 1 tab.

25464 (INDC(NDS)–262/GNC) **11. IAEA consultants' meeting of the nuclear reaction data centers. Obninsk, 7-11 October 1991: Summary report.** Lemmel, H.D. (ed.). International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Mar 1992. [101p.] (CONF-9110491–: 11. IAEA consultants' meeting of the nuclear reaction data centers, Obninsk (Russian Federation), 7-11 Oct 1991). Order Number DE93626598. Source: OSTI; NTIS (US Sales Only); INIS.

This report summarizes the 1991 co-ordination meeting in Obninsk, Russia, of the national and regional nuclear reaction data centers, convened by the IAEA at regular intervals. The main topics are: the international exchange of nuclear reaction data by means of the "EXFOR" system, and the further development of this system; the "CINDA" system as an international index and bibliography to neutron reaction data; the sharing of the workload for speedy and reliable nuclear data compilation; the exchanged and documentation of evaluated data libraries in ENDF format, with the goal of rendering data center services to data users in IAEA Member States by means of computer retrievals, online services and printed materials.

25465 (INDC(NDS)–262/GNC, pp. 26-28) **CJD progress report.** Manokhin, V. International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Mar 1992. (CONF-9110491–: 11. IAEA consultants' meeting of the nuclear reaction data centers, Obninsk (Russian Federation), 7-11 Oct 1991). In *11. IAEA consultants' meeting of the nuclear reaction data centers. Obninsk, 7-11 October 1991: Summary report.* [101p.] Order Number DE93626598. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. NUCLEAR DATA COLLECTIONS; DATA COMPILATION; NATIONAL ORGANIZATIONS; NEUTRON REACTIONS; PROGRESS REPORT; RUSSIAN FEDERATION

25466 (INDC(NDS)–262/GNC, pp. 29) **Report of CAJaD.** Chukreev, F.E. International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Mar 1992. (CONF-9110491–: 11. IAEA consultants' meeting of the nuclear reaction data centers, Obninsk (Russian Federation), 7-11 Oct 1991). In *11. IAEA consultants' meeting of the nuclear reaction data centers. Obninsk, 7-11 October 1991: Summary report.* [101p.] Order Number DE93626598. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. NUCLEAR DATA COLLECTIONS; DATA COMPILATION; NATIONAL ORGANIZATIONS; NUCLEAR REACTIONS; PROGRESS REPORT; RUSSIAN FEDERATION

25467 (INDC(NDS)–262/GNC, pp. 38-50) **Progress on nuclear data work in China.** Cai Dunjiu (Institute of Atomic Energy, Beijing (China). Chinese Nuclear Data Center). International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Mar 1992. (CONF-9110491–: 11. IAEA consultants' meeting of the nuclear reaction data centers, Obninsk (Russian Federation), 7-11 Oct 1991). In *11. IAEA consultants' meeting of the nuclear reaction data centers. Obninsk, 7-11 October 1991: Summary report.* [101p.] Order Number DE93626598. Source: OSTI; NTIS (US Sales Only); INIS.

Recent years we have made great efforts to prepare CENDL-2 and to improve the evaluation further. Therefore, advanced evaluation and theoretical calculation methods and programs have been or are being developed. (author). 25 refs, 3 figs.

25468 (INDC(NDS)–262/GNC, pp. 51-54) **The activities on CENDL, EXFOR, CINDA and WRENDA in China.** Liang Qichang (Institute of Atomic Energy, Beijing (China). Chinese Nuclear Data Center). International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Mar 1992. (CONF-9110491–: 11. IAEA consultants' meeting of the nuclear reaction data centers, Obninsk (Russian Federation), 7-11 Oct 1991). In *11. IAEA consultants' meeting of the nuclear reaction data centers. Obninsk, 7-11 October 1991: Summary report.* [101p.] Order Number DE93626598. Source: OSTI; NTIS (US Sales Only); INIS.

The report gives information about the activities of the Chinese Nuclear Data Center concerning the nuclear library CENDL-2, the EXFOR software system, CINDA and WRENDA libraries. 5 refs.

25469 (INDC(NDS)–262/GNC, pp. 55-57) **Data activities in RIKEN nuclear data group: Status report.** Tendow, Y. International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Mar 1992. (CONF-9110491–: 11. IAEA consultants' meeting of the nuclear reaction data centers, Obninsk (Russian Federation), 7-11 Oct 1991). In *11. IAEA consultants' meeting of the nuclear reaction data centers. Obninsk, 7-11 October 1991: Summary report.* [101p.] Order Number DE93626598. Source: OSTI; NTIS (US Sales Only); INIS.

The report presents the activities of the RIKEN Nuclear Data Group concerning the EXFOR, ENSDF and NSR files.

25470 (INDC(NDS)–262/GNC, pp. 58-60) **Japan charged-particle nuclear reaction data groupe: Status report.** Chiba, M. (Sapporo Gakuin Univ., Bunkyodai, Hokkaido (Japan)). International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Mar 1992. (CONF-9110491–: 11. IAEA consultants' meeting of the nuclear reaction data centers, Obninsk (Russian Federation), 7-11 Oct 1991). In *11. IAEA consultants' meeting of the nuclear reaction data centers. Obninsk, 7-11 October 1991: Summary report.* [101p.] Order Number DE93626598. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. NUCLEAR DATA COLLECTIONS/nuclear reactions; JAPANESE ORGANIZATIONS; PROGRESS REPORT

25471 (INDC(NDS)–262/GNC, pp. 61-65) **NEA Data Bank progress report to the NRDC meeting in Obninsk/Moscow, October 1991.** Nordborg, C. International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Mar 1992. (CONF-9110491–: 11. IAEA consultants' meeting of the nuclear reaction data centers, Obninsk (Russian Federation), 7-11 Oct 1991). In *11. IAEA consultants' meeting of the nuclear reaction data centers. Obninsk, 7-11 October 1991: Summary report.* [101p.] Order Number DE93626598. Source: OSTI; NTIS (US Sales Only); INIS.

The report presents shortly the activities of the NEA Data Bank concerning computer program services (testing, masterfiling and program distribution), nuclear data services (CINDA and EXFOR activities, customer service and Joint Evaluated File) and nuclear science activities (international evaluation cooperation and validation of computer codes and data).

25472 (INDC(NDS)–262/GNC, pp. 66-70) **National Nuclear Data Center. Status report.** Pearlstein, S. International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Mar 1992. (CONF-9110491–: 11. IAEA consultants' meeting of the nuclear reaction data centers, Obninsk (Russian Federation), 7-11 Oct 1991). In *11. IAEA consultants' meeting of the nuclear reaction data centers. Obninsk, 7-11 October 1991: Summary report.* [101p.] Order Number DE93626598. Source: OSTI; NTIS (US Sales Only); INIS.

The report presents the activities of the US National Nuclear Data Center, Brookhaven National Laboratory, concerning the bibliographies published, data libraries, evaluated nuclear reaction data, nuclear structure data, customer service, computer facilities, other publications. 2 figs, 1 tab.

25473 (INDC(NDS)–262/GNC, pp. 71-81) **IAEA Nuclear Data Section. Progress report.** Lemmel, H.D. International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Mar 1992. (CONF-9110491–: 11. IAEA consultants' meeting of the nuclear reaction data centers, Obninsk (Russian Federation), 7-11 Oct 1991). In *11. IAEA consultants' meeting of the nuclear reaction data centers. Obninsk, 7-11 October 1991: Summary report.* [101p.] Order Number DE93626598. Source: OSTI; NTIS (US Sales Only); INIS.

The report presents the activities of the IAEA Nuclear Data Section concerning CINDA, EXFOR system, data evaluation, publications. Included are the request statistics for 1989-1991 and the NDS meeting calendar for 1991-1994. Tabs.

25474 (ORAU–88/C-71) **Emergency management: An annotated bibliography.** Oak Ridge Associated Universities, Inc., TN (United States). Mar 1988. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-76OR00033. Order Number DE93013315. Source: OSTI; NTIS; GPO Dep.

Training Resources and Data Exchange (TRADE) is an organization designed to increase communication and exchange of ideas, information, and resources among US Department of Energy contractors and DOE personnel. Oak Ridge Associated Universities, located in Oak Ridge, Tennessee, manages TRADE for the DOE. The Emergency Preparedness Special Interest Group (EP SIG) is a group formed within TRADE for emergency preparedness coordinators and trainers to share information about emergency preparedness training and other EP resources. This bibliography was prepared for the EP SIG as a resource for EP training and planning activities.

25475 (ORNL/FTR–4245) **[Document description and processing languages]: Foreign trip report, 24 April–11 May 1992.** Mason, J.D. Oak Ridge National Lab., TN (United States). 26 May 1992. 45p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93011079. Source: OSTI; NTIS (US Sales Only); GPO Dep.

As DOE seeks to move towards electronic production, management, and dissemination of scientific and technical information and the adoption of government and international standards to support that effort, it has for several years been involved in the development of such international standards for text preparation and interchange. In support of this effort, the traveler serves as Convenor of ISO/IEC JTC1/SC18/WG8; during this trip he convened the Spring 1992 meeting of WG8 in Copenhagen, Denmark, and then represented WG8 at the annual Plenary of SC18, the committee including WG8, in Stockholm, Sweden.

9904 Law

25476 (INIS-XN–438) **Amendment of the Act of 29 March 1958 on protection of the population against the hazards of ionizing radiation.** Belgium. 30 Jun 1992. [2p.] (In French). Order Number DE93626593. Source: OSTI; NTIS (US Sales Only); INIS.

Published in Moniteur belge.

The amendments made by this Act concern the levying of fees to be decided by the King for the State or approved organisations to cover the costs of control, administration and emergency planning. (NEA).

Corporate Author Index

This index lists the corporate authors responsible for issuing the documents in this publication which are identified primarily by report number. The corporate names are entered in standardized forms as defined in ETDE/PUB–3, *International Energy: Research Organizations 1986–1990*. Each entry under a corporate name includes the document title and citation number. Three items of information may appear in parentheses: (1) an abbreviation to identify the document type, such as a report; (2) the country of publication, indicated by International Organization for Standardization (ISO) country code; and (3) the language of the document if non-English (R;CA;In French). Author affiliations are not listed in this index.

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Alaska Univ., Fairbanks, AK (United States). Geophysical Inst.
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AC07-81NE44139	**Oak Ridge National Lab., TN (United States)**	
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AC07-84ID12435	**Westinghouse Idaho Nuclear Co., Inc., Idaho Falls, ID (United States)**	
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AC07-92ID13167	**Jason Associates Corp., San Diego, CA (United States)**	
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AC08-88NV10617	**EG and G Energy Measurements, Inc., Las Vegas, NV (United States)**	
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	EG and G Energy Measurements, Inc., Goleta, CA (United States). Santa Barbara Operations	
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	EG and G Energy Measurements, Inc., Albuquerque, NM (United States). Kirtland Operations	
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	EG and G Energy Measurements, Inc., Las Vegas, NV (United States). Remote Sensing Lab.	
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AC08-89NV10733	**URS/John A. Blume and Associates, Engineers, San Francisco, CA (United States)**	
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AC08-90NV10845	**Nevada Univ., Reno, NV (United States). Quaternary Sciences Center**	
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AC08-91NV10833	**Raytheon Services Nevada, Las Vegas, NV (United States)**	
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AC09-76SR00001	**Du Pont de Nemours (E.I.) and Co., Aiken, SC (United States). Savannah River Lab.**	
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AC09-76SR00819	**Savannah River Ecology Lab., Aiken, SC (United States)**	
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	State Univ. of New York, Buffalo, NY (United States)	
	18:24725	DOE/ER/60727–T2
AC09-89SR18035	**Du Pont de Nemours (E.I.) and Co., Aiken, SC (United States). Savannah River Lab.**	
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	Westinghouse Savannah River Co., Aiken, SC (United States)	
	18:22890	WSRC-TR–92-582-Rev.1
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	18:22917	ASD-NMP–93-0014
	18:23069	WSRC-MS–91-104-Rev.1
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	18:23073	WSRC-MS–93-204
	18:23074	WSRC-MS–93-207
	18:23076	WSRC-RP–89-261
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	18:23185	WSRC-MS–93-148
	18:23454	WSRC-TR–92-357
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AC11-89PN38014	**Bettis Atomic Power Lab., West Mifflin, PA (United States)**	
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AC12-76SN00052	**Knolls Atomic Power Lab., Schenectady, NY (United States)**	
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AC21-86MC23166	**Solar Turbines, Inc., San Diego, CA (United States)**	
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AC21-87MC11089	**Institute of Gas Technology, Chicago, IL (United States)**	
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AC21-87MC24116	**Coal Technology Corp., Bristol, VA (United States)**	
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AC21-87MC24267	**North Dakota Univ., Grand Forks, ND (United States). Energy and Environmental Research Center**	
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AC21-88MC24258	**Cottrell Environmental Sciences, Somerville, NJ (United States)**	
	18:22758	DOE/MC/24258–3362
AC21-88MC25141	**USDOE Morgantown Energy Technology Center, WV (United States)**	
	18:22698	DOE/MC/25141–3340
	Caterpillar, Inc., Peoria, IL (United States)	
	18:22697	DOE/MC/25141–3339
AC21-88MC25168	**Ceramatec, Inc., Salt Lake City, UT (United States)**	
	18:23790	DOE/MC/25168–3291
AC21-92MC29116	**SRI International, Menlo Park, CA (United States)**	
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AC21-92MC29234	**ABB Power Generation, Inc., North Brunswick, NJ (United States). Turbine Power Div.**	
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AC22-87PC79936	**SRI International, Menlo Park, CA (United States)**	
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AC22-89PC89908	Aspen Technology, Inc., Cambridge, MA (United States)	
	18:22650	DOE/PC/89908–T29
AC22-90BC14472	University of Wyoming Research Corp., Laramie, WY (United States). Western Research Inst.	
	18:22791	DOE/BC/14472–11
AC22-90BC14657	Appalachian Oil and Natural Gas Research Consortium, Morgantown, WV (United States)	
	18:22792	DOE/BC/14657–12
AC22-90PC90035	Oklahoma State Univ., Stillwater, OK (United States)	
	18:24102	DOE/PC/90035–T6
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AC22-90PC90043	North Carolina State Univ., Raleigh, NC (United States). Dept. of Chemical Engineering	
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AC22-90PC90044	Lehigh Univ., Bethlehem, PA (United States)	
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AC22-90PC90184	Lovelace Medical Foundation, Albuquerque, NM (United States)	
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AC22-90PC90361	North Dakota Univ., Grand Forks, ND (United States). Energy and Environmental Research Center	
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AC22-91PC90181	New Jersey Inst. of Tech., Newark, NJ (United States). Particulate Flow Research Lab.	
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AC22-91PC90364	ADA Technologies, Inc., Englewood, CO (United States)	
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AC22-91PC90366	Battelle, Columbus, OH (United States)	
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AC22-91PC91041	Viking Systems International, Inc., Pittsburgh, PA (United States)	
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AC22-91PC91042	Pennsylvania State Univ., University Park, PA (United States). Dept. of Materials Science and Engineering	
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AC22-91PC91043	Western Research Inst., Laramie, WY (United States)	
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AC22-91PC91054	Pittsburgh Univ., PA (United States). Dept. of Chemical and Petroleum Engineering	
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AC22-91PC91059	Engineering Resources, Inc., Fayetteville, AR (United States)	
	18:22718	DOE/PC/91059–T4
AC22-91PC91345	Research Triangle Inst., Research Triangle Park, NC (United States)	
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AC22-92BC14881	Kansas Univ., Lawrence, KS (United States)	
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AC22-92BC14882	University of Southern Mississippi, Hattiesburg, MS (United States). Dept. of Polymer Science	
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AC22-92BC14884	Columbia Univ., New York, NY (United States). Lowell Memorial Library	
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AC22-92BC14886	Surtek, Inc., Golden, CO (United States)	
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AC22-92MT92001	Continental Shelf Associates, Inc., Jupiter, FL (United States)	
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AC22-92MT92007	Rice Univ., Houston, TX (United States). Dept. of Environmental Sciences and Engineering	
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AC22-92MT92008	Pennsylvania State Univ., University Park, PA (United States). Dept. of Mineral Engineering	
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AC22-92MT92009	Resource Technology Corp., Laramie, WY (United States)	
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AC22-92MT92012	Mission Research Corp., San Diego, CA (United States)	
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AC22-92PC91050	Canadian Energy Development, Inc., Edmonton, AB (Canada)	
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AC22-92PC91344	SRI International, Menlo Park, CA (United States)	
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AC22-92PC91346	Carnegie-Mellon Univ., Pittsburgh, PA (United States). Center for Energy and Environmental Studies	
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AC22-92PC92111	Massachusetts Inst. of Tech., Cambridge, MA (United States)	
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AC22-92PC92118	Engineering Resources, Inc., Fayetteville, AR (United States)	
	18:24104	DOE/PC/92118–T1
AC22-92PC92205	Virginia Center for Coal and Minerals Processing, Blacksburg, VA (United States)	
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AC22-92PC92207	Process Technology, Inc., Calumet, MI (United States)	
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AC22-93BC14860	Surtek, Inc., Golden, CO (United States)	
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AC34-90DP62349	EG and G Rocky Flats, Inc., Golden, CO (United States)	
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AI08-92NV10874	Geological Survey, Denver, CO (United States)	
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FC21-86MC11076	Western Research Inst., Laramie, WY (United States)	
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FC21-87MC24132	American Electric Power Service Corp., Columbus, OH (United States)	
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FC21-88MC25048	Illinois Univ., Urbana, IL (United States). Dept. of Mechanical and Industrial Engineering	
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FC21-91MC27364	Midwest Power, Des Moines, IA (United States)	
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FC22-83FE60149	National Inst. for Petroleum and Energy Research, Bartlesville, OK (United States)	
	18:22822	NIPER–578
	18:22823	NIPER–663
	18:22824	NIPER–686
FC22-91PC90544	Alaska Industrial Development and Export Authority, Anchorage, AK (United States)	
	18:23338	DOE/PC/90544–T6
FC22-91PC90547	Energy and Environmental Research Corp., Irvine, CA (United States)	
	18:22764	DOE/PC/90547–T10
FC22-92PC92521	Illinois Dept. of Energy and Natural Resources, Springfield, IL (United States)	
	18:22721	DOE/PC/92521–T7
	18:22722	DOE/PC/92521–T13
	18:22723	DOE/PC/92521–T19
	18:22724	DOE/PC/92521–T30
	18:22725	DOE/PC/92521–T32
	18:22738	DOE/PC/92521–T28
	18:22740	DOE/PC/92521–T2
	18:22741	DOE/PC/92521–T3
	18:22767	DOE/PC/92521–T4
	18:24068	DOE/PC/92521–T33

Contract No.	Abstract No.	Report No.
	18:24105	DOE/PC/92521–T29
	18:24470	DOE/PC/92521–T31
FC22-93BC14951	Tulsa Univ., OK (United States)	
	18:22800	DOE/BC/14951–1
FC22-93BC14952	Anderman/Smith Operating Co., Denver, CO (United States)	
	18:22801	DOE/BC/14952–2
FC22-93BC14958	Lomax Exploration Co., Salt Lake City, UT (United States)	
	18:22802	DOE/BC/14958–2
FC22-93BC14959	Texas Univ., Austin, TX (United States). Bureau of Economic Geology	
	18:22803	DOE/BC/14959–2
FG01-89CE15382	Smart Drain, Inc., Farmingdale, NY (United States)	
	18:23808	DOE/CE/15382–T2
FG01-89CE15407	Harmony Thermal Co., Inc., Greeley, CO (United States)	
	18:23809	DOE/CE/15407–T13
FG01-90CE26602	Drexel Univ., Philadelphia, PA (United States)	
	18:23847	DOE/CE/26602–4
	Drexel Univ., Philadelphia, PA (United States). Dept. of Mechanical Engineering and Mechanics	
	18:23844	DOE/CE/26602–1
	18:23845	DOE/CE/26602–2
	18:23846	DOE/CE/26602–3
FG01-91CE15492	Xform, Inc., Cohoes, NY (United States)	
	18:23926	DOE/CE/15492–T4
FG01-92CE15553	S-Cal Research Corp., San Rafael, CA (United States)	
	18:22804	DOE/CE/15553–T3
FG02-84ER13255	Washington Univ., St. Louis, MO (United States)	
	18:23195	DOE/ER/13255–9
FG02-84ER45125	Northwestern Univ., Evanston, IL (United States)	
	18:24010	DOE/ER/45125–10
FG02-84ER45133	Purdue Univ., Lafayette, IN (United States). School of Materials Engineering	
	18:25201	DOE/ER/45133–5
FG02-84ER45147	Indiana Univ., Bloomington, IN (United States)	
	18:23971	DOE/ER/45147–8
FG02-85ER13361	Marine Biological Lab., Woods Hole, MA (United States)	
	18:24866	DOE/ER/13361–T4
FG02-85ER13370	Cornell Univ., Ithaca, NY (United States)	
	18:23196	DOE/ER/13370–T2
FG02-85ER45205	Michigan State Univ., East Lansing, MI (United States). Dept. of Metallurgy, Mechanics and Material Science	
	18:24011	DOE/ER/45205–8
FG02-85ER53198	Wisconsin Univ., Madison, WI (United States). Plasma Physics Research	
	18:25234	DOE/ER/53198–218
FG02-85ER53212	Wisconsin Univ., Madison, WI (United States). Plasma Physics Research	
	18:25235	DOE/ER/53212–212
FG02-85ER60372	Columbia Univ., Palisades, NY (United States). Lamont-Doherty Geological Observatory	
	18:24579	DOE/ER/60372–8
FG02-86ER13560	United Technologies Research Center, East Hartford, CT (United States)	
	18:23969	DOE/ER/13560–7
FG02-86ER13641	Northwestern Univ., Evanston, IL (United States)	
	18:24242	DOE/ER/13641–7
FG02-86ER45228	Arizona State Univ., Tempe, AZ (United States)	
	18:23972	DOE/ER/45228–65
FG02-86ER45229	Argonne National Lab., IL (United States). Materials Science Div.	
	18:23915	ANL/MSD/CP–79532
FG02-86ER60487	Cincinnati Univ., OH (United States). Dept. of Chemistry	
	18:24856	DOE/ER/60487–7
FG02-87ER13717	Wisconsin Univ., Madison, WI (United States). Dept. of Plant Pathology	
	18:23197	DOE/ER/13717–3
FG02-87ER13726	Chicago Univ., IL (United States). Enrico Fermi Inst.	
	18:24985	DOE/ER/13726–6
FG02-87ER13734	Yale Univ., New Haven, CT (United States)	
	18:24840	DOE/ER/13734–4
FG02-87ER13740	Stevens Inst. of Tech., Hoboken, NJ (United States)	
	18:24986	DOE/ER/13740–10
FG02-87ER25047	Northwestern Univ., Evanston, IL (United States)	
	18:25392	DOE/ER/25047–5
FG02-87ER40333	Wyoming Univ., Laramie, WY (United States)	
	18:25158	DOE/ER/40333–137
	18:25159	DOE/ER/40333–138
	18:25233	DOE/ER/40333–136
FG02-87ER45289	Massachusetts Inst. of Tech., Cambridge, MA (United States). Dept. of Materials Science and Engineering	
	18:23916	CONF-8905118–14
FG02-87ER60539	New York Univ., NY (United States). Dept. of Environmental Medicine	
	18:24878	DOE/ER/60539–11
FG02-87ER60547	New York Univ. Medical Center, NY (United States). Dept. of Environmental Medicine	
	18:23811	DOE/ER/60547–5
FG02-87ER60561	Michigan Univ., Ann Arbor, MI (United States). Div. of Nuclear Medicine	
	18:24857	DOE/ER/60561–8
FG02-88ER12813	Texas A and M Univ., College Station, TX (United States)	
	18:24240	DOE/ER/12813–T1
	18:24241	DOE/ER/12813–T2
FG02-88ER13878	Minnesota Univ., Minneapolis, MN (United States)	
	18:24134	DOE/ER/13878–5
FG02-88ER13906	Indiana Univ., Bloomington, IN (United States). Dept. of Chemistry	
	18:23970	DOE/ER/13906–5
FG02-88ER13909	Cornell Univ., Ithaca, NY (United States)	
	18:24842	DOE/ER/13909–3
FG02-88ER13978	Indiana Univ., Bloomington, IN (United States)	
	18:24950	DOE/ER/13978–4
FG02-88ER40413	Brookhaven National Lab., Upton, NY (United States)	
	18:25032	BNL–48648
	18:25091	BNL–48649
FG02-88ER60727	State Univ. of New York, Buffalo, NY (United States)	
	18:24725	DOE/ER/60727–T2
	State Univ. of New York, Buffalo, NY (United States). Dept. of Biology	
	18:24724	DOE/ER/60727–T1
FG02-89ER12890	Florida Univ., Gainesville, FL (United States). Dept. of Nuclear Engineering Sciences	
	18:24875	CONF-900679–13

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FG02-89ER14024	Akron Univ., OH (United States). Dept. of Chemistry	
	18:24117	DOE/ER/14024–4
FG02-89ER14056	Michigan State Univ., East Lansing, MI (United States). Dept. of Chemistry	
	18:24844	DOE/ER/14056–14
FG02-89ER14062	Pittsburgh Univ., PA (United States)	
	18:24009	DOE/ER/14062–3
FG02-89ER45401	Harvard Univ., Cambridge, MA (United States). Div. of Applied Sciences	
	18:23928	DOE/ER/45401–4
FG02-89ER45403	Northwestern Univ., Evanston, IL (United States). Dept. of Materials Science and Engineering	
	18:23929	DOE/ER/45403–4
FG02-89ER53297	Princeton Univ., NJ (United States). Plasma Physics Lab.	
	18:25281	PPPL–2896
FG02-89ER60851	Utah Univ., Salt Lake City, UT (United States)	
	18:24851	DOE/ER/60851–4
FG02-90ER14119	Rochester Univ., NY (United States). Dept. of Physics and Astronomy	
	18:25172	CONF-9205147–5
FG02-90ER45413	Delaware Univ., Newark, DE (United States). Dept. of Physics and Astronomy	
	18:23974	DOE/ER/45413–3
FG02-90ER54084	Princeton Univ., NJ (United States). Plasma Physics Lab.	
	18:25281	PPPL–2896
FG02-90ER60964	Northeastern Univ., Boston, MA (United States)	
	18:24927	DOE/ER/60964–4
FG02-90ER60977	Wyoming Univ., Laramie, WY (United States). Dept. of Geography and Recreation	
	18:24727	DOE/ER/60977–4
FG02-90ER61033	Boston Univ., MA (United States)	
	18:24858	DOE/ER/61033–3
FG02-91CE23810	Illinois Univ., Urbana, IL (United States). Dept. of Mechanical and Industrial Engineering	
	18:24007	DOE/CE/23810–11C
	Air-Conditioning and Refrigeration Technology Inst., Inc., Arlington, VA (United States)	
	18:24004	DOE/CE/23810–11
	18:23810	DOE/CE/23810–7
	18:24002	DOE/CE/23810–6
	18:24003	DOE/CE/23810–8C
	18:24008	DOE/CE/23810–11D
	Imagination Resources, Inc., Dublin, OH (United States)	
	18:24006	DOE/CE/23810–11B
	Spauschus Associates, Inc., Stockbridge, GA (United States)	
	18:24005	DOE/CE/23810–11A
FG02-91ER12120	Science Research Lab., Inc., Somerville, MA (United States)	
	18:23169	DOE/ER/12120–1
FG02-91ER14182	Northwestern Univ., Evanston, IL (United States)	
	18:24244	DOE/ER/14182–2
FG02-91ER14187	Delaware Univ., Newark, DE (United States)	
	18:24064	DOE/ER/14187–1
FG02-91ER14194	Lawrence Livermore National Lab., CA (United States)	
	18:24963	UCRL-JC–111981
FG02-91ER20050	Pennsylvania State Univ., University Park, PA (United States). Dept. of Biology	
	18:24845	DOE/ER/20050–2
	18:24846	DOE/ER/20050–T1
FG02-91ER40643	Wisconsin Univ., Madison, WI (United States). Applied Superconductivity Center	
	18:23927	DOE/ER/40643–2
FG02-91ER40645	Brookhaven National Lab., Upton, NY (United States)	
	18:25032	BNL–48648
	18:25091	BNL–48649
FG02-91ER40646	Montreal Univ., PQ (Canada). Dept. of Physics	
	18:25034	CONF-921122–54-App.1
	Pittsburgh Univ., PA (United States). Dept. of Physics and Astronomy	
	18:24435	CONF-920837–45
	18:25035	DOE/ER/40646–3
FG02-91ER40672	Colorado Univ., Boulder, CO (United States). Dept. of Physics	
	18:25010	DOE/ER/40672–2
FG02-91ER40681	Purdue Univ., Lafayette, IN (United States). Dept. of Physics	
	18:25011	DOE/ER/40681–2
FG02-91ER54110	Massachusetts Inst. of Tech., Cambridge, MA (United States). Plasma Fusion Center	
	18:25228	DOE/FTR–93013656
	18:25303	DOE/FTR–93012118
FG02-91NP00119	Virginia Polytechnic Inst., Blacksburg, VA (United States)	
	18:25340	CONF-9110444–2
	Virginia Polytechnic Inst. and State Univ., Blacksburg, VA (United States). Dept. of Industrial and Systems Engineering	
	18:25341	CONF-9205327–1
	18:25342	CONF-9209334–1
FG02-92ER14263	Connecticut Univ., Storrs, CT (United States)	
	18:25184	DOE/ER/14263–1
FG02-92ER14280	Purdue Univ., Lafayette, IN (United States)	
	18:24096	DOE/ER/14280–1
FG02-92ER14281	Purdue Univ., Lafayette, IN (United States). Dept. of Chemistry	
	18:24097	DOE/ER/14281–1
FG02-92ER14289	Wisconsin Univ., Milwaukee, WI (United States)	
	18:24098	DOE/ER/14289–1
FG02-92ER14301	Colorado State Univ., Fort Collins, CO (United States)	
	18:24099	DOE/ER/14301–1
FG02-92ER14302	Pennsylvania State Univ., University Park, PA (United States). Gas Dynamics Lab.	
	18:23924	CONF-9306130–3
FG02-92ER25136	Utah State Univ., Logan, UT (United States). Dept. of Mathematics and Statistics	
	18:25393	DOE/ER/25136–1
FG02-92ER30196	E and S Environmental Chemistry, Inc., Corvallis, OR (United States)	
	18:24722	DOE/ER/30196–3
FG02-92ER40731	Cornell Univ., Ithaca, NY (United States)	
	18:24294	DOE/ER/40731–1
FG02-92ER45465	Oak Ridge National Lab., TN (United States)	
	18:24001	CONF-930822–4
FG02-92ER61438	Marine Biological Lab., Woods Hole, MA (United States). Ecosystems Center	
	18:24815	DOE/ER/61438–T1

Contract No.	Abstract No.	Report No.
FG02-92ER75700	Iowa State Univ. of Science and Technology, Ames, IA (United States). Dept. of Mechanical Engineering	
	18:23518	CONF-930433–8
FG02-92ER75728	Michigan Univ., Ann Arbor, MI (United States). Dept. of Nuclear Engineering	
	18:23551	DOE/ER/75728–1
FG02-92ER75729	Illinois Univ., Urbana, IL (United States)	
	18:23552	DOE/ER/75729–1
FG03-88ER53275	Lawrence Livermore National Lab., CA (United States)	
	18:25331	UCRL-JC–110398
FG03-89ER13991	California Univ., La Jolla, CA (United States)	
	18:24243	DOE/ER/13991–1
FG03-92ER61484	New Mexico Inst. of Mining and Technology, Socorro, NM (United States)	
	18:24730	DOE/ER/61484–5
FG03-93ER14348	Texas Univ., Austin, TX (United States). Dept. of Physics	
	18:25173	DOE/ER/13191–13
FG05-80ET53088	Texas Univ., Austin, TX (United States). Inst. for Fusion Studies	
	18:25236	DOE/ET/53088–599
	Lawrence Livermore National Lab., CA (United States)	
	18:25331	UCRL-JC–110398
FG05-84ER13191	Texas Univ., Austin, TX (United States). Dept. of Physics	
	18:25173	DOE/ER/13191–13
FG05-84ER40159	Louisiana State Univ., Baton Rouge, LA (United States). Dept. of Physics and Astronomy	
	18:25067	DOE/ER/40159–199
FG05-85ER13357	Auburn Univ., AL (United States). Dept. of Chemical Engineering	
	18:24063	DOE/ER/13357–22
FG05-85ER13439	Rice Univ., Houston, TX (United States)	
	18:24116	DOE/ER/13439–8
FG05-85ER13456	Tennessee Univ., Knoxville, TN (United States). Dept. of Physics	
	18:25174	DOE/ER/13456–50
FG05-86ER40256	Oak Ridge National Lab., TN (United States)	
	18:25093	CONF-930197–3
FG05-86ER40272	Florida Univ., Gainesville, FL (United States). Inst. for Fundamental Theory	
	18:25023	DOE/ER/40272–182
FG05-86ER40293	Middle Tennessee State Univ., Murfreesboro, TN (United States). Dept. of Chemistry and Physics	
	18:25097	DOE/ER/40293–7
FG05-86ER45233	Rice Univ., Houston, TX (United States)	
	18:25211	DOE/ER/45233–8
FG05-87ER13711	Texas A and M Univ., College Station, TX (United States). Center for Tectonophysics	
	18:22778	DOE/ER/13711–T2
FG05-87ER40309	Brookhaven National Lab., Upton, NY (United States)	
	18:25032	BNL–48648
	18:25091	BNL–48649
FG05-87ER40314	Lawrence Berkeley Lab., CA (United States)	
	18:25070	LBL–33903
	18:25079	LBL–33959
FG05-87ER40321	Maryland Univ., College Park, MD (United States). Dept. of Chemistry	
	18:25100	DOE/ER/40321–11
	Maryland Univ., College Park, MD (United States). Dept. of Chemistry and Biochemistry	
	18:25098	DOE/ER/40321–8
	18:25099	DOE/ER/40321–10
FG05-87ER40322	Washington Univ., Seattle, WA (United States). Inst. for Nuclear Theory	
	18:25024	DOE/ER/40561–098
FG05-87ER40361	Oak Ridge National Lab., TN (United States)	
	18:25064	CONF-9209342–1
	18:25066	CONF-9211199–7
	Tennessee Univ., Knoxville, TN (United States). Dept. of Physics and Astronomy	
	18:25063	CONF-9205108–19
FG05-87ER45316	Virginia Commonwealth Univ., Richmond, VA (United States)	
	18:25175	DOE/ER/45316–T1
FG05-87ER52141	Lawrence Livermore National Lab., CA (United States)	
	18:25325	UCRL-JC–109811-Rev.1
FG05-87ER60572	Duke Univ., Durham, NC (United States)	
	18:24926	DOE/ER/60572–T2
FG05-88ER13971	Toledo Univ., OH (United States). Dept. of Physics and Astronomy	
	18:25183	DOE/ER/13971–20
FG05-88ER40437	Texas A and M Univ., College Station, TX (United States). Cyclotron Inst.	
	18:25081	DOE/ER/40437–4
FG05-88ER45359	North Carolina State Univ., Raleigh, NC (United States). Dept. of Materials Science and Engineering	
	18:23973	DOE/ER/45359–2
FG05-88ER60692	Baylor Univ., Houston, TX (United States). Inst. of Molecular Genetics	
	18:24850	DOE/ER/60692–5
FG05-89ER14065	Virginia Polytechnic Inst. and State Univ., Blacksburg, VA (United States)	
	18:24095	DOE/ER/14065–T1
FG05-89ER40530	Tennessee Technological Univ., Cookeville, TN (United States)	
	18:25082	DOE/ER/40530–8
FG05-89ER45406	Rutgers–the State Univ., New Brunswick, NJ (United States)	
	18:25223	DOE/ER/45406–1
FG05-90ER60991	Memphis State Univ., TN (United States). Dept. of Biology	
	18:24728	DOE/ER/60991–T1
	18:24729	DOE/ER/60991–T2
FG05-90ER75582	California Inst. of Tech., Pasadena, CA (United States). Dept. of Chemistry	
	18:24065	DOE/ER/75582–T1
FG05-91ER14181	North Carolina State Univ., Raleigh, NC (United States)	
	18:25200	DOE/ER/14181–1
FG05-91ER14213	Rice Univ., Houston, TX (United States). Dept. of Space Physics and Astronomy	
	18:25232	DOE/ER/14213–1
FG05-91ER40642	Maryland Univ., College Park, MD (United States)	
	18:24345	CONF-9206193–25
FG05-91ER40660	Houston Univ., TX (United States). Inst. for Beam Particle Dynamics	
	18:24436	DOE/ER/40660–1
FG05-91ER54134	Auburn Univ., AL (United States). Dept. of Mechanical Engineering	
	18:23930	DOE/ER/54134–2
FG05-93ER40770	Oak Ridge National Lab., TN (United States)	
	18:25066	CONF-9211199–7

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FG06-84ER45163	Washington Univ., Seattle, WA (United States). Dept. of Physics	
	18:25210	DOE/ER/45163–33
FG06-84ER60247	Alaska Univ., Fairbanks, AK (United States)	
	18:24723	DOE/ER/60247–T4
FG06-86ER13530	Alaska Univ., Fairbanks, AK (United States). Geophysical Inst.	
	18:24984	DOE/ER/13530–5
FG06-86ER25019	Washington Univ., Seattle, WA (United States)	
	18:24966	DOE/ER/25019–T1
FG06-88ER40427	Washington Univ., Seattle, WA (United States)	
	18:25073	DOE/ER/40427–21-N92
	Washington Univ., Seattle, WA (United States). Dept. of Physics	
	18:25014	DOE/ER/40427–32-N92
	18:25015	DOE/ER/40427–36-N92
FG06-90ER40561	Washington Univ., Seattle, WA (United States)	
	18:25073	DOE/ER/40427–21-N92
	18:25101	DOE/ER/40561–080
	Washington Univ., Seattle, WA (United States). Inst. for Nuclear Theory	
	18:25024	DOE/ER/40561–098
FG06-91ER40637	Oregon Univ., Eugene, OR (United States)	
	18:25102	DOE/ER/40637–6
FG06-92ER61417	Oregon Univ., Eugene, OR (United States). Dept. of Biology	
	18:24580	DOE/ER/61417–1
FG07-89ER60847	Idaho Univ., Moscow, ID (United States). Center for Hazardous Waste Remediation Research	
	18:24726	DOE/ER/60847–T1
FG08-85NV10461	Nevada Nuclear Waste Project Office, Carson City, NV (United States)	
	18:23009	NWPO-SE–045-92
	18:23010	NWPO-SE–054-92
	18:23011	NWPO-TR–017-91
	18:23012	NWPO-TR–018-91
FG09-84ER13188	Georgia Univ., Athens, GA (United States). Research Foundation	
	18:23259	DOE/ER/13188–8
FG09-87ER13810	Georgia Univ., Athens, GA (United States). Complex Carbohydrate Research Center	
	18:24841	DOE/ER/13810–6
FG09-87SR15191	South Carolina Wildlife and Marine Resources Dept., Columbia, SC (United States)	
	18:24739	DOE/SR/15191–6
	18:24740	DOE/SR/15191–7
FG09-88ER13970	Georgia Univ., Athens, GA (United States). Complex Carbohydrate Research Center	
	18:24843	DOE/ER/13970–4
FG09-90ER14156	Georgia Univ., Athens, GA (United States). Research Foundation	
	18:24118	DOE/ER/14156–2
FG09-90SR18159	Claflin Coll., Orangeburg, SC (United States)	
	18:24741	DOE/SR/18159–2
FG09-91SR18217	Medical Univ. of South Carolina, Charleston, SC (United States). Dept. of Biostatistics, Epidemiology, and System Sciences	
	18:24883	DOE/SR/18217–1
FG09-92SR18271	Selma Univ., AL (United States). Div. of Natural Sciences	
	18:24742	DOE/SR/18271–1
FG21-89MC26031	New Mexico Inst. of Mining and Technology, Socorro, NM (United States). New Mexico Petroleum Recovery Research Center	
	18:22805	DOE/MC/26031–11
FG21-90MC27225	Arkansas Univ., Fayetteville, AR (United States)	
	18:23213	DOE/MC/27225–3344
FG21-90MC27401	West Virginia Univ., Morgantown, WV (United States). Dept. of Mechanical and Aerospace Engineering	
	18:22863	DOE/MC/27401–3332
FG22-83PC60781	SRI International, Menlo Park, CA (United States)	
	18:22660	CONF-891001–13
FG22-85PC80906	SRI International, Menlo Park, CA (United States)	
	18:22660	CONF-891001–13
FG22-86PC90537	Utah Univ., Salt Lake City, UT (United States). Dept. of Fuels Engineering	
	18:22705	DOE/PC/90537–T2
	18:22706	DOE/PC/90537–T3
	18:22707	DOE/PC/90537–T4
	18:22708	DOE/PC/90537–T5
	18:22709	DOE/PC/90537–T6
	18:22710	DOE/PC/90537–T7
	18:22711	DOE/PC/90537–T8
FG22-88PC88940	Utah Univ., Salt Lake City, UT (United States)	
	18:22699	DOE/PC/88940–T14
FG22-89BC14246	Oklahoma Univ., Norman, OK (United States)	
	18:22790	DOE/BC/14246–11
FG22-89BC14425	Alabama Geological Survey, Tuscaloosa, AL (United States)	
	18:22776	DOE/BC/14425–T13-App.1-Vol.1
	18:22777	DOE/BC/14425–T13-App.1-Vol.4
FG22-89PC89781	Cincinnati Univ., OH (United States). Coll. of Engineering	
	18:22700	DOE/PC/89781–12
	18:22701	DOE/PC/89781–13
FG22-89PC89784	Lehigh Univ., Bethlehem, PA (United States)	
	18:24100	DOE/PC/89784–T2
FG22-89PC89786	Pittsburgh Univ., PA (United States). Dept. of Chemical and Petroleum Engineering	
	18:23214	DOE/PC/89786–T16
FG22-89PC89788	Utah Univ., Salt Lake City, UT (United States). Dept. of Fuels Engineering	
	18:22702	DOE/PC/89788–T12
FG22-90PC90284	Alabama Univ., University, AL (United States). Dept. of Chemistry	
	18:22735	DOE/PC/90284–10
FG22-90PC90292	Clark Atlanta Univ., GA (United States)	
	18:23334	DOE/PC/90292–T10
FG22-90PC90310	Texas A and M Univ., College Station, TX (United States). Dept. of Mechanical Engineering	
	18:22763	DOE/PC/90310–T11
FG22-91PC91281	Auburn Univ., AL (United States). Dept. of Chemical Engineering	
	18:22719	DOE/PC/91281–T5
FG22-91PC91284	Stanford Univ., CA (United States). Dept. of Civil Engineering	
	18:22765	DOE/PC/91284–2
	18:23339	DOE/PC/91284–5

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FG22-91PC91306	**Tennessee Univ., Knoxville, TN (United States). Dept. of Chemistry**	
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FG22-92BC14852	**Stanford Univ., CA (United States). Dept. of Petroleum Engineering**	
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FG22-92PC92548	**Washington Univ., Seattle, WA (United States). Dept. of Mechanical Engineering**	
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CONF-870789–		(4. international conference on multiphoton processes (ICOMP IV); Boulder, CO (United States); 13-17 Jul 1987)			
5	18:25194	OSTI; NTIS; GPO Dep.	E 1.99:	DE93011367	MF-700
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CONF-8809159–		(14. world conference of the International Nuclear Target Development Society (INTDS): heavy-ion targets and related phenomena; Darmstadt (Germany); 5-9 Sep 1988)			
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CONF-8901232–		(1. research co-ordination meeting on atomic and molecular data for radiotherapy; Vienna (Austria); 30 Jan - 2 feb 1989)			
	18:25187	*See* INDC(NDS)–217/GZ			
CONF-8904446–		(IAEA specialists' meeting on required atomic database for neutral beam penetration in large tokamaks; Vienna (Austria); 10-12 Apr 1989)			
	18:25251	*See* INDC(NDS)–225/MS			
CONF-8905118–		(2. international conference on trends in welding research; Gatlinburg, TN (United States); 15-19 May 1989)			
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CONF-890615–		(Building simulation '89; Vancouver (Canada); 23-24 Jun 1989)			
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CONF-8906428–		(Advisory group meeting on development and evaluation of alternative radioanalytical methods, including mass spectrometry for marine materials; Monaco (Monaco); 6-9 Jun 1989)			
	18:24071	*See* IAEA-TECDOC–683			
CONF-890786–		(US particle accelerator school; Upton, NY (United States); 24 Jul - 4 aug 1989)			
5	18:24296	*See* BNL–48346			
CONF-8909498–		(Consultants' meeting on compilation and evaluation of fission yield nuclear data; Vienna (Austria); 27-29 Sep 1989)			
	18:25121	*See* INDC(NDS)–261/GSp			
CONF-890977–		(International congress on intergranular and interphase boundaries in materials; Paris (France); 4-8 Sep 1989)			
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CONF-891001–		(1989 international conference on coal science; Tokyo (Japan); 23-27 Oct 1989)			
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CONF-9005397–		(IAEA Advisory Group meeting on atomic and molecular (A and M) data for metallic impurities in fusion plasmas: Collision processes of metallic ions in fusion plasmas; Vienna (Austria); 16-18 May 1990)			
	18:25256	*See* INDC(NDS)–236/M5			
CONF-9006441–		(IAEA consultants' meeting on thermal response of plasma facing materials and components; Vienna (Austria); 11-13 Jun 1990)			
	18:25307	*See* INDC(NDS)–237/M6			
CONF-900679–		(1990 Health Physics Society meeting; Anaheim, CA (United States); 24-28 Jun 1990)			
13	18:24875	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93010315	MF-408
CONF-9007123–		(ISEC'90: international solvent extraction conference; Kyoto (Japan); 16-21 Jul 1990)			
	18:22879	*See* CEA-CONF–11229			
CONF-9011322–		(Advanced sensors technical conference; Atlanta, GA (United States); 12-13 Nov 1990)			
1	18:24257	*See* DOE/CE/40777–9			
CONF-9011327–		(IAEA advisory group meeting on nuclear data for neutron multiplication in fusion-reactor first-wall and blanket materials; Chengdu (China); 19-21 Nov 1990)			
	18:25308	*See* INDC(NDS)–264/G			
CONF-9104215–		(HAZMACON '91; Santa Clara, CA (United States); 16-18 Apr 1991)			
3	18:24790	*See* UCRL-JC–106541			
CONF-9104345–		(1991 JAIF international conference on water chemistry in nuclear power plants; Fukui (Japan); 22-25 Apr 1991)			
	18:23375	*See* CEA-CONF–11281			

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
CONF-9104368–		(4. international conference on carbonaceous particles in the atmosphere; Vienna (Austria); 3-5 Apr 1991)			
1-Rev.1	18:24649	*See* UCRL-JC–108523			
CONF-9104418–		(2. France-Israel Symposium on Robotics. Advances in non-manufacturing robotics; Saclay (France); 8-10 Apr 1991)			
	18:24142	*See* CEA-CONF–11230			
CONF-9105202–		(1. energy research power supercomputer users symposium; Gaithersburg, MD (United States); 21-22 May 1991)			
9	18:24648	*See* UCRL-JC–108020			
CONF-9105418–		(1991 Spring Materials Research Society (MRS) meeting; Baltimore, MD (United States); May 1991)			
1	18:24051	*See* UCRL-JC–105732			
CONF-910559–		(10. annual international incineration conference: environmental concerns and controls; Knoxville, TN (United States); 13-17 May 1991)			
	18:22923	*See* CEA-CONF–11231			
CONF-9106429–		(IAEA consultants' meeting on He-beam data base for alpha particle diagnostics fo fusion plasmas; Vienna (Austria); 3-5 Jun 1991)			
	18:25257	*See* INDC(NDS)–253/N2			
CONF-9106430–		(IAEA consultants' meeting on atomic data base for Be and B; Vienna (Austria); 10-12 Jun 1991)			
	18:25259	*See* INDC(NDS)–254			
CONF-910659–		(84. annual meeting and exhibition of the Air and Waste Management Association (AWMA); Vancouver (Canada); 16-21 Jun 1991)			
36	18:24647	*See* UCRL-JC–107143			
CONF-9107146–		(16. international conference on defects in semiconductors; Bethlehem, PA (United States); 22-26 Jul 1991)			
	18:25207	*See* CEA-CONF–11233			
	18:25208	*See* CEA-CONF–11234			
CONF-9107230–		(International symposium on ground water in practice; Nashville, TN (United States); 29 Jul - 2 aug 1991)			
2	18:23350	*See* LBL–30933			
CONF-9107235–		(SNOWMASS meeting; Denver, CO (United States); 21 Jul - 10 aug 1991)			
1	18:24657	*See* UCRL-JC–110922			
CONF-910774–		(32. Institute of Nuclear Materials Management (INMM) annual meeting; New Orleans, LA (United States); 28-31 Jul 1991)			
106-Rev.1	18:23153	*See* K/CSD/INF–87/13-Rev.1			
CONF-9108114–		(2. international symposium on chemistry in high temperature water; Provo, UT (United States); 19-22 Aug 1991)			
	18:23376	*See* CEA-CONF–11283			
	18:24091	*See* CEA-CONF–11282			
CONF-9108150–		(9. international conference on positron annihilation; Szombathely (Hungary); 26-31 Aug 1991)			
	18:23989	*See* CEA-CONF–11235			
CONF-9109266–		(International Atomic Energy Agency (IAEA) specialists meeting on status of graphite development for gas-cooled reactors; Tokai (Japan); 9-12 Sep 1991)			
	18:24016	*See* IAEA-TECDOC–690			
CONF-9109312–		(12. Air movement and ventilation control (AIVC) within buildings conference; Ottawa (Canada); 24-27 Sep 1991)			
3	18:23797	*See* AUC-IBT-R–9150			
4	18:23796	*See* AUC-IBT-R–9149			

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
CONF-9109485–		(IAEA advisory group meeting on atomic and molecular data for fusion plasma impurities; Vienna (Austria); 25-27 Sep 1991)			
	18:25262	*See* INDC(NDS)–257/N8			
CONF-910968–		(14. IEEE symposium on fusion engineering; San Diego, CA (United States); 30 Sep - 3 oct 1991)			
81	18:25322	*See* UCRL-JC–107242			
CONF-9110232–		(Symposium on Relativistic Heavy Ion Collider (RHIC) detector R&D; Upton, NY (United States); 10-11 Oct 1991)			
	18:24432	*See* BNL–52321			
CONF-9110326–		(European conference on laser interaction with matter (ECLIM); Warsaw (Poland); 21-25 Oct 1991)			
2	18:25169	*See* UCRL-JC–107601			
CONF-9110444–		(27. annual meeting of the Institute of Management Sciences; Myrtle Beach, SC (United States); 3-4 Oct 1991)			
2	18:25340	OSTI; NTIS; GPO Dep.	E 1.99:	DE93010317	MF-1000
CONF-9110490–		(EUROCORR'91; Budapest (Hungary); 21-25 Oct 1991)			
	18:23377	*See* CEA-CONF–11284			
	18:23378	*See* CEA-CONF–11285			
CONF-9110491–		(11. IAEA consultants' meeting of the nuclear reaction data centers; Obninsk (Russian Federation); 7-11 Oct 1991)			
	18:25464	*See* INDC(NDS)–262/GNC			
CONF-9110492–		(Institute of Electrical and Electronics Engineers/American Institute of Aeronautics and Astronautics (IEEE/AIAA) digital avonics system conference; Los Angeles, CA (United States); 14-17 Oct 1991)			
1	18:24502	*See* UCRL-JC–107850			
CONF-911069–		(3. international conference on mechanical and physical behavior of materials under dynamic loading; Strasbourg (France); 14-18 Oct 1991)			
11	18:24263	*See* UCRL-JC–106122			
CONF-9111146–		(1. research co-ordination meeting on activation cross-sections for the generation of long-lived radionuclides of importance in fusion reactor technology; Vienna (Austria); 11-12 Nov 1991)			
	18:25124	*See* INDC(NDS)–263/GSp			
CONF-9111295–		(Environmental research conference multimedia approach on integrated environmental protection; Toronto (Canada); 25-26 Nov 1991)			
1	18:24798	*See* UCRL-JC–110622			
CONF-9111305–		(Department of Energy industry advanced sensors technical conference; Cincinnati, OH (United States); 11 Nov 1991)			
1	18:24431	*See* DOE/CE/40777–10			
CONF-911131–		(10. international workshop on laser interaction and related plasma phenomena; Monterey, CA (United States); 11-15 Nov 1991)			
4	18:25326	*See* UCRL-JC–109977			
CONF-9111312–		(8. international maintenance conference; Dallas, TX (United States); 12-14 Nov 1991)			
1	18:24178	*See* UCRL-JC–106140			
CONF-9111318–		(95. PTB seminar 'Dose measurement techniques for high-energy photon and electron radiation'; Braunschweig (Germany); 11-12 Nov 1991)			
	18:24452	*See* PTB-Dos–21			
CONF-911202–		(Annual fall meeting of the Materials Research Society; Boston, MA (United States); 2-6 Dec 1991)			
88	18:23953	*See* UCRL-JC–109229			
89	18:24474	*See* UCRL-JC–109348			

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
CONF-911296–		(14. international conference on laser and applications; San Diego, CA (United States); 8-13 Dec 1991)			
	18:24274	*See* ENEA-RT-INN–92-04			
CONF-9201148–		(73. American Meteorological Society (AMS) meeting; Anaheim, CA (United States); 17-22 Jan 1992)			
1	18:24656	*See* UCRL-JC–110846			
CONF-9202172–		(NASA high speed research program models and measurements workshop; Satellite Beach, FL (United States); 2-7 Feb 1992)			
1	18:24651	*See* UCRL-JC–108847			
CONF-920307–		(Waste management '92; Tucson, AZ (United States); 1-5 Mar 1992)			
93	18:23051	*See* UCRL-JC–109901			
CONF-920315–		(3. European particle accelerator conference (EPAC-3): Accelerators for special applications; Berlin (Germany); 24-28 Mar 1992)			
46	18:24347	*See* FNAL/C–92-239			
47	18:24309	*See* BNL–48679			
CONF-9203159–		(9. international workshop on photon-photon collisions; San Diego, CA (United States); 22-26 Mar 1992)			
9	18:25033	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93011742	MF-414
CONF-9203164–		(International workshop on the physics and techniques of secondary nuclear beams; Dourdan (France); 23-25 Mar 1992)			
3	18:24297	*See* BNL–48604			
CONF-9203238–		(North Atlantic Treaty Organization (NATO) advanced research workshop on time dependent quantum molecular dynamics: experiments and theory; Snowbird, UT (United States); 30 Mar - 3 apr 1992)			
2	18:25198	*See* UCRL-JC–110145			
CONF-920362–		(9. topical conference on high-temperature plasma diagnostics; Santa Fe, NM (United States); 15-19 Mar 1992)			
44	18:25283	*See* UCRL-JC–109369			
45	18:25323	*See* UCRL-JC–109253			
47	18:25324	*See* UCRL-JC–109796			
CONF-920367–		(Department of Defense (DOD) fiber optics conference; McLean, VA (United States); 25 Mar 1992)			
9	18:24556	*See* UCRL-JC–108751			
CONF-9204112–		(2. small satellite technology and applications; Orlando, FL (United States); 20-24 Apr 1992)			
3	18:24052	*See* UCRL-JC–110245			
4	18:24563	*See* UCRL-JC–110272			
CONF-9204120–		(Soft-x-ray projection lithography topical meeting; Monterey, CA (United States); 6-8 Apr 1992)			
5	18:25181	*See* UCRL-JC–110217			
7	18:24291	*See* UCRL-JC–111714			
8	18:24290	*See* UCRL-JC–111712			
CONF-9204121–		(Innovative technologies for cleaning the environment: air, water, and soil; Erice (Italy); 22-29 Apr 1992)			
4	18:24799	*See* UCRL-JC–110957			
CONF-9204126–		(B factories: state of the art in accelerators, detectors, and physics; Stanford, CA (United States); 6-10 Apr 1992)			
20	18:24426	*See* UCRL-JC–112275			
CONF-9204146–		(Fusion Power Associates annual meeting and symposium; Pleasanton, CA (United States); 9 Apr 1992)			
5	18:25334	*See* UCRL-JC–111382			
6	18:25333	*See* UCRL-JC–111381			
CONF-9204235–		(1992 Air Force high energy density materials contractors meeting; Lancaster, CA (United States); 12-14 Apr 1992)			
2-Rev.1	18:24114	*See* UCRL-JC–110049-Rev.1			

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
CONF-9204236–		(75. ISS-AIME steelmaking conference; Toronto (Canada); 5-8 Apr 1992)			
1	18:24268	*See* EGG-M–92069			
CONF-9204241–		(Ascona workshop on muonic atomic and molecules; Ascona (Switzerland); 5-9 Apr 1992)			
1	18:25158	*See* DOE/ER/40333–137			
2	18:25159	*See* DOE/ER/40333–138			
CONF-920430–		(3. international high level radioactive waste management (IHLRWM) conference; Las Vegas, NV (United States); 12-16 Apr 1992)			
104	18:23050	*See* UCRL-JC–108815			
CONF-920435–		(17. general assembly of the European Geophysical Society; Edinburgh (United Kingdom); 6-10 Apr 1992)			
1	18:24571	OSTI; NTIS (US Sales Only)		DE93795283	
CONF-920466–		(Engineering and technology conference on waste management and environmental restoration; San Juan (Puerto Rico); 9-11 Apr 1992)			
17	18:23019	*See* PNL-SA–20592			
CONF-920471–		(International Society for Photo Optical Engineering (SPIE) conference; Orlando, FL (United States); 20-24 Apr 1992)			
7	18:24562	*See* UCRL-JC–110271			
CONF-9205108–		(International conference on nuclear structure at high angular momentum; Ottawa (Canada); 18-21 May 1992)			
19	18:25063	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014276	MF-413
CONF-9205147–		(10. symposium on energy engineering sciences: synergism of analysis, modeling, and experiment; Argonne, IL (United States); 11-13 May 1992)			
5	18:25172	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013437	MF-410
CONF-920515–		(9. international conference on high power particle beams; Washington, DC (United States); 25-29 May 1992)			
33	18:25332	*See* UCRL-JC–110868			
CONF-9205215–		(American industrial hygiene conference and exposition; Boston, MA (United States); 30 May - 5 jun 1992)			
3	18:24650	*See* UCRL-JC–108641			
CONF-920523–		(3. international colloquium on x-ray lasers; Schliersee (Germany); 18-22 May 1992)			
9	18:25284	*See* UCRL-JC–109804			
10	18:24287	*See* UCRL-JC–110974			
11	18:24289	*See* UCRL-JC–111392			
12	18:25327	*See* UCRL-JC–110000			
13	18:24288	*See* UCRL-JC–111233			
CONF-920527–		(1992 incineration conference; Albuquerque, NM (United States); 11-14 May 1992)			
10	18:23142	*See* PNL-SA–20922			
11	18:23020	*See* PNL-SA–20802			
13	18:24138	*See* UCRL-JC–108866			
15	18:23052	*See* UCRL-JC–110079			
CONF-9205327–		(International industrial engineering conference; Chicago, IL (United States); May 1992)			
1	18:25341	OSTI; NTIS; GPO Dep.	E 1.99:	DE93010316	MF-1000
CONF-9205345–		(Workshop on objectives for next generation of practical short-range atmospheric dispersion models; Roskilde (Denmark); 6-8 May 1992)			
	18:24596	*See* NEI-DK–1102			
CONF-9205346–		(Organization for Economic Cooperation and Development, Nuclear Energy Agency Nuclear Science Committee (NEANSC) specialists' meeting on Fission Product Nuclear Data; Tokaimura (Japan); 25-27 May 1992)			
	18:25160	*See* ECN-RX–92-040			

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
CONF-920605–		(American Nuclear Society annual meeting; Boston, MA (United States); 7-12 Jun 1992)			
44	18:25335	*See* UCRL-JC–111389			
45	18:24791	*See* UCRL-JC–109508			
CONF-920607–		(10. topical meeting on technology of fusion energy; Boston, MA (United States); 7-12 Jun 1992)			
22	18:25318	*See* UCRL-CR–109549			
CONF-9206114–		(Annual meeting of the Air and Waste Management Association (AWMA); Kansas City, MO (United States); 21-26 Jun 1992)			
21	18:23141	*See* PNL-SA–20747			
CONF-9206129–		(1992 American Electroplaters and Surface Finishers Society conference (AESF SUR/FIN 92); Atlanta, GA (United States); 22-25 Jun 1992)			
5	18:23952	*See* UCRL-JC–108750			
CONF-9206172–		(Solid state sensor and actuator workshop; Hilton Head Island, SC (United States); 21-25 Jun 1992)			
3	18:24473	*See* UCRL-JC–109342			
CONF-9206173–		(3. international conference on trends in welding research; Gatlinburg, TN (United States); 1-5 Jun 1992)			
11	18:23917	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012958	MF-404
CONF-9206193–		(Advanced accelerator concepts workshop; Port Jefferson, NY (United States); 14-20 Jun 1992)			
25	18:24345	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93010174	MF-414
CONF-9206202–		(NATO advanced study institute on statics and dynamics of alloy phase transformations; Rhodes (Greece); 21 Jun - 3 jul 1992)			
7	18:23957	*See* UCRL-JC–112060			
CONF-9206227–		(15. international conference on neutrino physics; Granada (Spain); 7-13 Jun 1992)			
7	18:25073	*See* DOE/ER/40427–21-N92			
CONF-9206235–		(International Atomic Energy Agency (IAEA) technical committee meeting on advances in simulation and modeling of thermonuclear plasmas; Montreal (Canada); 15-17 Jun 1992)			
6	18:25328	*See* UCRL-JC–110193			
CONF-9206247–		(19. European Physical Society (EPS) conference on controlled fusion and plasma physics; Innsbruck (Austria); 29 Jun - 4 jul 1992)			
2	18:25317	*See* PPPL–2879			
6	18:25277	*See* PPPL–2882			
CONF-9206276–		(Muon '92 workshop; Uppsala (Sweden); 28 Jun - 3 jul 1992)			
5	18:25233	*See* DOE/ER/40333–136			
CONF-9206297–		(International symposium on optical fabric testing and surface evaluation; Tokyo (Japan); 6 Jun 1992)			
2	18:24488	*See* UCRL-JC–110274			
CONF-9206314–		(TASI summer school; Cargese summer school on quantitative particle physics; Varenna summer school on galaxy formation; Boulder, CO (United States); Corsica (France); Varenna (Italy); 11-29 Jun 1992; jul 1992; jul 1992)			
2	18:24988	*See* FNAL/C–92/313-A			
CONF-9206335–		(International symposium on automotive technology and automation; Florence (Italy); 1-5 Jun 1992)			
3	18:23830	*See* UCRL-JC–109420			
4	18:23697	*See* UCRL-JC–109422			

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CONF-9206363–		(Field workshop on ecological stability of landscape, ecological infrastructure and ecological management; Kostelec nad Cernymi Lesy (Czechoslovakia); 15-20 Jun 1992)			
	18:22743	*See* INIS-mf–13519			
CONF-9206369–		(IMORN-23; Nykoeping (Sweden); 3-5 Jun 1992)			
	18:25407	*See* KFKI–1992-25/G			
CONF-9206371–		(Symposium on fundamentals of discrete time systems; Chicago, IL (United States); 26-27 Jun 1992)			
1	18:25439	*See* UCRL-JC–111956			
CONF-920689–		(Symposium on ballistics; Stockholm (Sweden); 1-3 Jun 1992)			
6	18:24501	*See* UCRL-JC–107113			
CONF-920690–		(Atomic layer epitaxy; Raleigh, NC (United States); 3-5 Jun 1992)			
1	18:23181	*See* SAND–93-0864C			
CONF-920708–		(2. international nuclear physics conference; Wiesbaden (Germany); 26 Jul - 1 aug 1992)			
7	18:25101	*See* DOE/ER/40561–080			
CONF-9207102–		(Institute of Nuclear Materials Management (INMM) annual meeting; Orlando, FL (United States); 19-22 Jul 1992)			
73	18:23158	*See* UCRL-JC–110107			
77	18:22905	*See* UCRL-JC–110999			
78	18:24179	*See* UCRL-JC–110015			
79	18:23154	*See* K/ITP–486			
80	18:23157	*See* UCRL-JC–110102			
CONF-9207189–		(Computational methods in genome research conference; Heidelberg (Germany); 1-4 Jul 1992)			
1	18:24854	*See* UCRL-JC–111419			
CONF-9207199–		(TASI summer school; Cargese summer school on quantitative particle physics; Varenna summer school on galaxy formation; Boulder, CO (United States); Corsica (France); Varenna (Italy); 11-29 Jun 1992; jul 1992; jul 1992)			
1	18:24988	*See* FNAL/C–92/313-A			
CONF-9207200–		(TASI summer school; Cargese summer school on quantitative particle physics; Varenna summer school on galaxy formation; Boulder, CO (United States); Corsica (France); Varenna (Italy); 11-29 Jun 1992; jul 1992; jul 1992)			
1	18:24988	*See* FNAL/C–92/313-A			
CONF-9207202–		(10. Mach reflection symposium; Denver, CO (United States); 20-23 Jul 1992)			
1	18:25005	*See* UCRL-JC–110564			
CONF-9207203–		(1. meeting of The Japan Institute of Energy and the 70th Foundation anniversary meeting; Tokyo (Japan); 22-24 Jul 1992)			
	18:23767	OSTI; NTIS; Available from The Japan Institute of Energy, 5-4, Sotokanda 6-chome, Chiyoda-ku, Tokyo (Japan)		DE93793523	
CONF-920721–		(6. international conference on nuclei far from stability and 9th international conference on atomic masses and fundamental constants; Bernkastel-Kues (Germany); 19-24 Jul 1992)			
	18:25139	*See* IPNO-DRE–92-32			
CONF-920735–		(10. international conference on vacuum ultraviolet radiation physics; Paris (France); 27-31 Jul 1992)			
6	18:25219	*See* UCRL-JC–111627			
CONF-920750–		(Institute of Electrical and Electronic Engineers Antennas and Propagation Society (IEEE-APS) international symposium; Chicago, IL (United States); 18-25 Jul 1992)			
7	18:24973	*See* UCRL-JC–110006			

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CONF-920761–		(7. water-rock interaction conference; Park City, UT (United States); 9-23 Jul 1992)			
17	18:24113	*See* UCRL-JC–109948			
CONF-920771–		(1992 summer computer simulation conference; Reno, NV (United States); 27-30 Jul 1992)			
6	18:24503	*See* UCRL-JC–109857			
CONF-920772–		(Topical meeting on the technology of fusion energy; Boston, MA (United States); 7-12 Jul 1992)			
2-Rev.1	18:25325	*See* UCRL-JC–109811-Rev.1			
CONF-920792–		(Society of Photo-Optical Instrumentation Engineers (SPIE) international symposium on optical applied science and engineering; San Diego, CA (United States); 19-24 Jul 1992)			
54	18:24465	*See* UCRL-JC–107306			
55	18:24913	*See* UCRL-JC–109590			
56	18:25007	*See* UCRL-JC–111495			
60	18:23182	*See* UCRL-JC–111802			
CONF-920803–		(Nuclear technologies for space exploration; Jackson, WY (United States); 16-19 Aug 1992)			
17	18:23469	*See* EGG-M–92502			
CONF-920804–		(28. national heat transfer conference; San Diego, CA (United States); 9-12 Aug 1992)			
27	18:23956	*See* UCRL-JC–111377			
CONF-920808–		(American Institute of Chemical Engineers (AIChE) summer national meeting; Minneapolis, MN (United States); 9-12 Aug 1992)			
15	18:23018	*See* PNL-SA–20281			
CONF-9208108–		(Workshop on computer security incident handling; Denver, CO (United States); Aug 1992)			
2	18:25435	*See* UCRL-JC–111212			
CONF-9208109–		(16. international LINAC conference; Ottawa (Canada); 23-28 Aug 1992)			
79	18:24425	*See* UCRL-JC–111229			
81	18:24313	*See* FNAL/C–92/389			
82	18:25329	*See* UCRL-JC–110202			
87	18:24295	*See* UCRL-JC–110204			
CONF-9208135–		(International conference on the physics of strongly coupled plasmas; Rochester, NY (United States); 17-21 Aug 1992)			
5	18:25286	*See* UCRL-JC–111903			
5	18:25205	*See* UCRL-JC–111904			
CONF-920815–		(204. American Chemical Society (ACS) national meeting; Washington, DC (United States); 23-28 Aug 1992)			
22-Pt.1	18:22862	*See* UCRL-JC–110320-Pt.1			
CONF-9208217–		(Pellston workshop on chemical bioavailability in aquatic systems; Pellston, MI (United States); 18-21 Aug 1992)			
1	18:24836	*See* UCRL-JC–112215			
CONF-920823–		(22. Department of Energy (DOE)/Nuclear Regulatory Commission (NRC) nuclear air cleaning and treatment conference; Denver, CO (United States); 24-27 Aug 1992)			
9	18:23508	*See* UCRL-JC–110582			
7-Rev.1	18:23148	*See* UCRL-JC–110582-Rev.1			
CONF-920837–		(ICHEP-26: 26th International Union of Pure and Applied Physics (IUPAP) conference on high energy physics; Dallas, TX (United States); 6-12 Aug 1992)			
45	18:24435	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013491	MF-414
CONF-920851–		(Spectrum '92: nuclear and hazardous waste management international topical meeting; Boise, ID (United States); 23-27 Aug 1992)			
86	18:24777	*See* PNL-SA–20740			
87	18:23143	*See* PNL-SA–20984			
88	18:24778	*See* PNL-SA–20853			
89	18:24779	*See* PNL-SA–20985			
90	18:24792	*See* UCRL-JC–110055			
92	18:22845	*See* UCRL-JC–109677			

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Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
93	18:23842	*See* UCRL-JC–110431			
94	18:24794	*See* UCRL-JC–110353			
CONF-920866–		(American Society of Civil Engineers (ASCE) symposium on dynamic analysis and design considerations, for high-level nuclear waste repositories; San Francisco, CA (United States); 19-20 Aug 1992)			
5	18:23001	*See* LBL–33614			
CONF-920881–		(11. international conference on clouds and precipitation; Montreal (Canada); 17-21 Aug 1992)			
2	18:24653	*See* UCRL-JC–110400			
CONF-920882–		(Transuranic waste characterization conference; Pocatello, ID (United States); 10-12 Aug 1992)			
3	18:23053	*See* UCRL-JC–110826			
4	18:23054	*See* UCRL-JC–110827			
CONF-920887–		(8. international symposium on thermodynamics of nuclear materials; Snowbird, UT (United States); 16-21 Aug 1992)			
	18:23990	*See* CEA-CONF–11236			
CONF-920893–		(Joint statistical meetings of the American Statistical Association, the Biometric Society and the Institute of Mathematical Statistics; Boston, MA (United States); 9-13 Aug 1992)			
7	18:25436	*See* UCRL-JC–111224			
CONF-920906–		(15. congress of the World Energy Council (WEC): energy and life; Madrid (Spain); 20-25 Sep 1992)			
3	18:23353	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93011866	MF-520
CONF-920913–		(14. international conference on plasma physics and controlled nuclear fusion research; Wuerzburg (Germany); 30 Sep - 7 oct 1992)			
28	18:25278	*See* PPPL–2890			
29	18:25279	*See* PPPL–2891			
30	18:25330	*See* UCRL-JC–110329			
CONF-9209158–		(10. symposium on turbulence and diffusion; Portland, OR (United States); 29 Sep - 2 oct 1992)			
12	18:24654	*See* UCRL-JC–110558			
CONF-9209159–		(Eurocourse: technologies for environmental cleanup - soil and groundwater; Ispra (Italy); 21-25 Sep 1992)			
4	18:24796	*See* UCRL-JC–110528			
5	18:24800	*See* UCRL-JC–110959			
6	18:24797	*See* UCRL-JC–110530			
7	18:24795	*See* UCRL-JC–110525			
CONF-9209181–		(International Atomic Energy Agency (IAEA) technical committee meeting on tokamak plasma biasing; Montreal (Canada); 8-10 Sep 1992)			
7	18:25321	*See* UCRL-JC–110-843			
CONF-9209184–		(The International Society for Optical Engineering (SPIE) meeting; Boston, MA (United States); 8-11 Sep 1992)			
8	18:24487	*See* UCRL-JC–109818			
CONF-9209204–		(Cray users group meeting; Washington, DC (United States); 14-18 Sep 1992)			
5	18:25440	*See* UCRL-JC–112015			
CONF-9209231–		(International symposium on exterior insulation and finish systems; Arlington, VA (United States); 21-24 Sep 1992)			
2	18:23798	OSTI; NTIS; GPO Dep.	E 1.99:	DE93011844	MF-350
CONF-9209253–		(Crystal 2000 international workshop on heavy scintillators for scientific and industrial applications; Chamonix (France); 22-26 Sep 1992)			
4	18:24449	*See* LBL–33295			
CONF-9209290–		(14. international conference on plasma physics and controlled nuclear fusion research; Wurzburg (Germany); 30 Sep - 7 oct 1992)			
8	18:25331	*See* UCRL-JC–110398			

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
9	18:25237	*See* GA-A–21046			
CONF-920930–		(17. symposium on fusion technology; Rome (Italy); 14-18 Sep 1992)			
	18:25288	*See* CEA-CONF–11238			
	18:25289	*See* CEA-CONF–11239			
	18:25290	*See* CEA-CONF–11240			
	18:25291	*See* CEA-CONF–11241			
CONF-9209325–		(4. International symposium on analysis and detection of explosives; Jerusalem (Israel); 7-10 Sep 1992)			
1	18:24517	*See* EGG-M–92417			
CONF-9209331–		(7. Brazilian Meteorological Congress: climate change and the environment; Sao Paulo (Brazil); 28 Sep - 2 oct 1992)			
2	18:24652	*See* UCRL-JC–109822			
CONF-9209332–		(Indian summer school; Sazava (Czech Republic); 7-10 Sep 1992)			
1	18:25014	*See* DOE/ER/40427–32-N92			
CONF-9209333–		(STRINGS '92; Rome (Italy); 2-8 Sep 1992)			
1	18:25029	*See* LBL–33232			
CONF-9209334–		(International conference on self-managing teams; Dallas, TX (United States); Sep - oct 1992)			
1	18:25342	OSTI; NTIS; GPO Dep.	E 1.99:	DE93010319	MF-1000
CONF-9209335–		(International Humic Substances Society meeting; Bari (Italy); 20-25 Sep 1992)			
1	18:24813	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93011861	MF-402
CONF-9209342–		(International conference on nuclear structure and nuclear reactions at low and intermediate energies; Dubna (Russian Federation); 15-19 Sep 1992)			
1	18:25064	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013273	MF-413
CONF-9209347–		(1. Joint Italian-Japanese meeting on perspectives in heavy ion physics; Catania (Italy); 29 Sep - 3 oct 1992)			
	18:25140	*See* IPNO-DRE–92-35			
CONF-9209352–		(4. Magdeburg seminar on prevention of water pollution - the situation of the river Elbe; Spindleruv Mlyn (Czechoslovakia); 22-26 Sep 1992)			
	18:24824	*See* GKSS–92/E/49			
CONF-9209353–		(2. international conference on modelling of global climate change and variability; Hamburg (Germany); 7-11 Sep 1992)			
1	18:24574	OSTI; NTIS (US Sales Only)		DE93792714	
CONF-9209358–		(OMAE'92 conference; Calgary (Canada); Sep 1992)			
	18:24272	*See* AUC-IBT-R–9242			
1	18:24270	*See* AUC-IBT-R–9240			
2	18:24271	*See* AUC-IBT-R–9241			
CONF-920947–		(Conference on nanostructured materials; Cancun (Mexico); 21-25 Sep 1992)			
5	18:23915	*See* ANL/MSD/CP–79532			
CONF-920948–		(6. international conference on physics of highly charged ions; Manhattan, KS (United States); 28 Sep - 2 oct 1992)			
12	18:25170	*See* UCRL-JC–111868			
CONF-920963–		(4. international colloquium on atomic spectra and oscillator strengths for astrophysics and laboratory plasmas; Gaithersburg, MD (United States); 14-17 Sep 1992)			
2	18:25280	*See* PPPL–2893			
CONF-920966–		(10. conference on computing in high energy physics; Annecy (France); 21-25 Sep 1992)			
26	18:24348	*See* FNAL/C–92/308			
CONF-921005–		(Institute of Electrical and Electronic Engineers (IEEE) nuclear science symposium and medical imaging conference; Orlando, FL (United States); 26-31 Oct 1992)			
30	18:24855	*See* BNL–48454			

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
CONF-921007–		(20. water reactor safety information meeting; Bethesda, MD (United States); 21-23 Oct 1992)			
21	18:23627	*See* BNL-NUREG–48542			
22	18:23625	*See* BNL-NUREG–47817			
26	18:23677	*See* UCRL-JC–111964			
27	18:23626	*See* BNL-NUREG–47971			
28	18:23628	*See* BNL-NUREG–48687			
Vol.1	18:23652	*See* NUREG/CP–0126-Vol.1			
Vol.2	18:23653	*See* NUREG/CP–0126-Vol.2			
Vol.3	18:23654	*See* NUREG/CP–0126-Vol.3			
CONF-921012–		(6. international conference on water chemistry of nuclear reactor systems; Bournemouth (United Kingdom); 12-15 Oct 1992)			
	18:23379	*See* CEA-CONF–11286			
	18:23380	*See* CEA-CONF–11287			
CONF-9210140–		(International fuels and lubricants meeting and exposition; San Francisco, CA (United States); 19-22 Oct 1992)			
2-Rev.1	18:23861	*See* UCRL-JC–110069-Rev.1			
CONF-9210249–		(1992 international symposium on rapidly rotating nuclei; Tokyo (Japan); 26-30 Oct 1992)			
10	18:25072	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93009668	MF-413
CONF-9210277–		(Workshop on the applications of synchrotron radiation to trace impurity analysis of advanced silicon processing; Stanford, CA (United States); 21 Oct 1992)			
	18:24088	*See* SLAC–415			
CONF-9210315–		(14. international conference on plasma physics and controlled nuclear fusion research; Wurzburg (Germany); Oct 1992)			
4	18:25281	*See* PPPL–2896			
CONF-9210326–		(Pacific Science Organization international symposium; Vancouver (Canada); 13-16 Oct 1992)			
1	18:24636	*See* PNL-SA–21478			
CONF-9210331–		(6. Usenix Systems Administration conference on large installation system administration; Long Beach, CA (United States); 19-23 Oct 1992)			
2	18:25433	*See* SLAC-PUB–5895			
CONF-9210334–		(17. annual climate diagnostics conference; Norman, OK (United States); 19-23 Oct 1992)			
1	18:24965	*See* UCRL-JC–112366			
CONF-9210337–		(1992 international conference of applications of particle accelerators; Denton, TX (United States); Oct 1992)			
1	18:25225	*See* BNL–48570			
CONF-9210339–		(Workshop on atomic physics; Ithaca, NY (United States); Oct 1992)			
1	18:25174	*See* DOE/ER/13456–50			
CONF-9210343–		(Workshop on coatings needs in the auto industry; Detroit, MI (United States); 27-28 Oct 1992)			
Exc.Summ.	18:23839	*See* PNL–8600			
CONF-9210349–		(4. International Seminar on Technology Transfer; 1. Brazilian Congress on Technology Transfer; Rio de Janeiro (Brazil); 4-9 Oct 1992)			
	18:25378	*See* INIS-BR–3127			
CONF-9210351–		(The mining town of Pribram in science and technology; Pribram (Czechoslovakia); 12-14 Oct 1992)			
	18:23087	*See* INIS-mf–13518			
CONF-9210353–		(CRAY User Group meeting; Washington, DC (United States); 9-13 Oct 1992)			
1	18:25438	*See* UCRL-JC–111883			
CONF-9210355–		(117. National congress of Scientist Societies; Clermont-Ferrand (France); 26-30 Oct 1992)			
	18:25155	*See* CEA-CONF–11245			

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
CONF-9210356–		(Laser-induced damage in optical materials; Boulder, CO (United States); 28-30 Oct 1992)			
1	18:23983	*See* UCRL-JC–111458			
CONF-9210360–		(European seminar on collective biogas plants. European experience in combined manure and waste processing; Herning (Denmark); 22-23 Oct 1992)			
	18:23198	*See* NEI-DK–1149			
CONF-921040–		(3. international workshop on real-time computing of the environmental consequences of an accidental release to atmosphere from a nuclear installation: decision-making support for offsite emergency management installation; Klais (Germany); 25-30 Oct 1992)			
1	18:24655	*See* UCRL-JC–110844			
CONF-921046–		(Symposium on nuclear data evaluation methodology; Upton, NY (United States); 12-16 Oct 1992)			
	18:25083	*See* ECN-RX–92-066			
	18:25103	*See* ECN-RX–92-064			
17	18:25061	*See* UCRL-JC–111831			
CONF-921047–		(Symposium on optical materials for high-power lasers; Boulder, CO (United States); 28-30 Oct 1992)			
4	18:24475	*See* UCRL-JC–111388			
CONF-921053–		(International Atomic Energy Agency technical committee meeting on atomic and plasma material interaction data for fusion reactor technology; Cadarache (France); 12-16 Oct 1992)			
3	18:25287	*See* ANL/EP/CP–78386			
CONF-921066–		(Oceans '92; Newport, RI (United States); 26-29 Oct 1992)			
3-Rev.1	18:24961	*See* UCRL-JC–107852-Rev.1			
CONF-921068–		(East-West topical meeting: the safe and reliable operation of light water reactor NPP's; Prague (Czechoslovakia); 18-21 Oct 1992)			
	18:23396	*See* INIS-mf–13503			
	18:23638	*See* INIS-mf–13502			
CONF-921077–		(Stability of particle motion in storage rings; Upton, NY (United States); 18-24 Oct 1992)			
4	18:24298	*See* BNL–48790			
CONF-921101–		(16. Material Research Society international symposium on the scientific basis for nuclear waste management fall meeting; Boston, MA (United States); 30 Nov - 5 dec 1992)			
112	18:24042	*See* PNL-SA–21238			
113	18:24041	*See* PNL-SA–21236			
114	18:23978	*See* SAND–93-0582C			
117	18:23955	*See* UCRL-JC–111004			
118	18:23981	*See* UCRL-JC–111025			
CONF-921102–		(Joint American Nuclear Society (ANS)/European Nuclear Society (ENS) international meeting on fifty years of controlled nuclear chain reaction: past, present, and future; Chicago, IL (United States); 15-20 Nov 1992)			
60	18:25156	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93009710	MF-413
61	18:23463	*See* WHC-SA–1602			
CONF-921103–		(Meeting of the Division of Plasma Physics of the American Physical Society; Seattle, WA (United States); 16-20 Nov 1992)			
10	18:25238	*See* GA-A–21128			
CONF-921110–		(Winter annual meeting of the American Society of Mechanical Engineers (ASME); Anaheim, CA (United States); 8-13 Nov 1992)			
49	18:25437	*See* UCRL-JC–111227			
CONF-9211101–		(Annual automotive development technology contractors' coordination meeting; Dearborn, MI (United States); 2-5 Nov 1992)			
8	18:23882	*See* UCRL-JC–111555			
9	18:23859	OSTI; NTIS; GPO Dep.	E 1.99:	DE93011860	MF-332

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
10	18:23192	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012764	MF-243
CONF-9211104–		(OPTCON '92: optical fabrication and testing workshop; Boston, MA (United States); 17 Nov 1992)			
8	18:24054	*See* UCRL-JC–111396			
CONF-9211116–		(38. annual conference on bioassay, analytical and environmental radiochemistry; Santa Fe, NM (United States); 2-6 Nov 1992)			
9	18:24876	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93009922	MF-700
10	18:24593	*See* FEMP–2270			
CONF-9211117–		(Minerals, Metals, and Materials Society/American Society for Metals (TMS/ASM) materials week '92; Chicago, IL (United States); 2-5 Nov 1992)			
6	18:24053	*See* UCRL-JC–110334			
7	18:23954	*See* UCRL-JC–110996			
CONF-9211128–		(1992 nuclear explosives code developers conference; Sunnyvale, CA (United States); 2-6 Nov 1992)			
7	18:25203	*See* SAND–92-1716C			
9	18:24557	*See* UCRL-JC–111562			
CONF-921115–		(5. international power generation industries conference and exposition; Orlando, FL (United States); 17-19 Nov 1992)			
1	18:22761	*See* DOE/METC/C–93/7062			
CONF-921119–		(American Society for Testing and Materials (ASTM) symposium on application of accelerated corrosion tests to life prediction of materials; Miami, FL (United States); 16-17 Nov 1992)			
3	18:22916	*See* ANL/MCT/CP–75243			
CONF-9211199–		(Symposium on nuclear physics of our times; Sanibel Island, FL (United States); 17-21 Nov 1992)			
4	18:25068	*See* EGG-M–92648			
5	18:25065	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013211	MF-413
6	18:25092	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012761	MF-413
7	18:25066	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012968	MF-413
CONF-9211208–		(National Ground Water Association (NGWA) meeting; Houston, TX (United States); 4-6 Nov 1992)			
1	18:24793	*See* UCRL-JC–110235			
CONF-921121–		(3. joint conference of European East-West conference on materials and processes and European Materials Research Society fall meeting; Strasbourg (France); 3-6 Nov 1992)			
2	18:23897	*See* ANL/MSD/CP–76872			
CONF-921122–		(Meeting of the Division of Particles and Fields of the American Physical Society; Batavia, IL (United States); 10-14 Nov 1992)			
48	18:25050	*See* BNL–48605			
49	18:24437	*See* FNAL/C–93/043-E			
50	18:25088	*See* BNL–48588			
51	18:25036	*See* FNAL/C–93/047/E			
54-App.1	18:25034	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013493	MF-414
56	18:24438	*See* FNAL/C–93/053-E			
58	18:25037	*See* FNAL/C–93/051-E			
59	18:25051	*See* FNAL/C–93/054-E			
CONF-9211227–		(Intelligent scheduling systems symposium; San Francisco, CA (United States); 1 Nov 1992)			
1	18:25396	*See* EGG-M–92595			
CONF-9211228–		(High energy neutron dosimetry workshop; Gaithersburg, MD (United States); 19 Nov 1992)			
1	18:24895	*See* LA-UR–93-747			
CONF-9211240–		(1992 annual Automotive Technology Development Contractors' Coordination meeting (ATD/CCM); Dearborn, MI (United States); 2-5 Nov 1992)			
1	18:23883	*See* BNL–48685			

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
CONF-9211246–		(8. topical meeting on nuclear code development; Tokai (Japan); 11-12 Nov 1992)			
	18:25404	*See* JAERI-M–93-033			
CONF-921129–		(39. national symposium of the American Vacuum Society; Chicago, IL (United States); 9-13 Nov 1992)			
8	18:24341	*See* BNL–47434			
9-Rev.3/93	18:24342	*See* BNL–47435-Rev.3/93			
CONF-921130–		(7. international cryocooler conference; Santa Fe, NM (United States); 15-19 Nov 1992)			
2	18:24981	*See* IS-M–746			
CONF-921131–		(10. international symposium on high-energy spin physics; Nagoya (Japan); 9-14 Nov 1992)			
10	18:25049	*See* SLAC-PUB–6068			
11	18:24380	*See* SLAC-PUB–6060			
12	18:25015	*See* DOE/ER/40427–36-N92			
CONF-921162–		(Hypervelocity impact symposium; Austin, TX (United States); 17-20 Nov 1992)			
16	18:25004	*See* UCRL-JC–110081			
CONF-921187–		(16. training resources and data exchange: managing for performance and results; Seattle, WA (United States); 2-4 Nov 1992)			
5	18:24942	*See* EGG-M–92571			
CONF-921204–		(International electron devices meeting; San Francisco, CA (United States); 6-9 Dec 1992)			
2	18:24292	*See* UCRL-JC–111945			
CONF-921265–		(1. geological materials constitutive modeling workshop; Los Alamos, NM (United States); 9-10 Dec 1992)			
	18:24955	*See* LA–12534-C			
CONF-921275–		(25. safety engineering study meeting; Kitakyushu (Japan); 2-3 Dec 1992)			
	18:23731	OSTI; NTIS; Available from Japan Soceity for Safety Engineering, 4-47, Onoecho, Naka-ku, Yokohama-shi, Kanagawa, Japan		DE93793904	
CONF-921276–		(1992 Japan Solar Energy Society, Japan Wind Energy Association joint converence; Osaka (Japan); 3-4 Dec 1992)			
	18:23227	OSTI; NTIS; Available from Japan Solar Energy Society, Sun Patio 322, 1-5, Takatanobaba 3-chome, Shinjuku-ku, Tokyo, Japan		DE93793955	
CONF-930103–		(10. symposium on space nuclear power and propulsion; Albuquerque, NM (United States); 10-14 Jan 1993)			
31	18:23636	*See* EGG-M–92569			
33	18:23468	*See* EGG-M–92413			
39	18:23854	*See* UCRL-JC–110921			
CONF-930107–		(2. Israeli international conference on high T_c superconductivity; Elat (Israel); 4-7 Jan 1993)			
2	18:23982	*See* UCRL-JC–111437			
CONF-930108–		(31. American Institute of Astronautics and Aeronautics (AIAA) aerospace sciences meeting; Reno, NV (United States); 11-14 Jan 1993)			
6	18:24136	*See* SAND–92-1168C			
CONF-9301100–		(1993 national symposium on shock waves; Sendai (Japan); 11-15 Jan 1993)			
1	18:25008	*See* UCRL-JC–112713			
CONF-9301102–		(American Nuclear Society (ANS) meeting; Clearwater, FL (United States); 27 Jan 1993)			
1	18:23676	*See* UCRL-JC–110420			
CONF-9301103–		(Global Foundation International conference on unified symmetry in the small and in the large; Coral Gables, FL (United States); 25-27 Jan 1993)			
1	18:25023	*See* DOE/ER/40272–182			
2	18:25054	*See* SSCL-Preprint–241			
CONF-9301106–		(Fusion Power Associates annual meeting; La Jolla, CA (United States); 28-29 Jan 1993)			
1	18:25292	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012762	MF-420

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CONF-9301109–		(2. international conference on physics and astrophysics of quark-gluon plasma; Calcutta (India); 19-23 Jan 1993)			
1	18:25094	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012755	MF-413
CONF-930116–		(Probabilistic safety assessment international topical meeting (PSA 93); Clearwater Beach, FL (United States); 27-29 Jan 1993)			
42	18:23607	*See* WSRC-MS–92-224			
43	18:23634	*See* EGG-M–92266			
45	18:23059	*See* WHC-SA–1544			
CONF-930130–		(26. Health Physics Society midyear topical meeting on environmental health physics; Coeur d'Alene, ID (United States); 24-28 Jan 1993)			
8	18:24832	*See* PNL-SA–21080			
9	18:24902	*See* PNL-SA–21011			
10	18:24903	*See* PNL-SA–21014			
12	18:23025	*See* PNL-SA–21459			
13	18:23144	*See* PNL-SA–21476			
15	18:24593	*See* FEMP–2270			
CONF-930133–		(73. American Meteorological Society (AMS) annual meeting; Anaheim, CA (United States); 17-22 Jan 1993)			
9	18:24637	*See* PNL-SA–21486			
10	18:24638	*See* PNL-SA–21492			
CONF-930135–		(International symposium on advanced electronic and optoelectronic materials; Los Angeles, CA (United States); 20-23 Jan 1993)			
4	18:24284	*See* SAND–93-0436C			
CONF-930142–		(4. American Meteorological Society (AMS) symposium on global change studies; Anaheim, CA (United States); 14-19 Jan 1993)			
4	18:24634	*See* PNL-SA–20914			
5	18:24635	*See* PNL-SA–21377			
CONF-930159–		(OE/LASE '93: International Society for Optical Engineering (SPIE) conference; Los Angeles, CA (United States); 16-23 Jan 1993)			
25	18:23958	*See* UCRL-JC–112518			
29	18:24377	*See* LBL–32480			
32	18:25006	*See* UCRL-JC–111173			
CONF-930160–		(2. semi-annual Office of Technology Development (OTD) information meeting; Houston, TX (United States); 26-28 Jan 1993)			
7	18:24781	*See* PNL-SA–21710			
8	18:23145	*See* PNL-SA–21731			
12	18:24802	*See* UCRL-JC–112395			
13	18:23055	*See* UCRL-JC–112397			
CONF-930163–		(IS&T/SPIE symposium on electronic imaging science and technology; San Jose, CA (United States); 31 Jan - 5 feb 1993)			
2	18:24476	*See* UCRL-JC–112602			
CONF-930168–		(Simulating accelerator radiation environments workshop; Santa Fe, NM (United States); 11-15 Jan 1993)			
5	18:24860	*See* FNAL/C–93/077			
CONF-930173–		(HIPAGS meeting; Cambridge, MA (United States); 14-17 Jan 1993)			
3	18:25087	*See* BNL–48587			
4	18:25090	*See* BNL–48634			
5	18:25089	*See* BNL–48594			
6	18:25021	*See* BNL–48736			
7	18:25032	*See* BNL–48648			
9	18:25091	*See* BNL–48649			
CONF-930182–		(10. Institute of Nuclear Materials Management spent fuel management seminar; Washington, DC (United States); 13-15 Jan 1993)			
1	18:22902	*See* PNL-SA–21727			
CONF-930184–		(3. SILAP conference; Hansui (Belgium); 8-14 Jan 1993)			
2	18:25192	*See* BNL–48611			

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CONF-930186–		(EPRI workshop on potential of HDR resources for the U.S. Electric Utility Industry; Philadelphia, PA (United States); 14 Jan 1993)			
1	18:23302	*See* LA-UR–93-735			
2	18:23303	*See* LA-UR–93-910			
CONF-930187–		(13. Moriond workshop on perspectives in neutrinos, atomic physics, and gravitation; Villars-sur-Ollon (Switzerland); 30 Jan - 6 feb 1993)			
2	18:25053	*See* LA-UR–93-1243			
CONF-930188–		(Environmental restoration technology transfer symposium; Salt Lake City, UT (United States); 26-28 Jan 1993)			
1	18:22993	*See* LA-UR–93-656			
CONF-930194–		(4. annual ACM-SIAM conference on discrete algorithms; Austin, TX (United States); 25-27 Jan 1993)			
1	18:25421	*See* SAND–92-1724C			
CONF-930195–		(2. Nassau Moessbauer conference; Garden City, NY (United States); 8 Jan 1993)			
1	18:25206	*See* BNL–48628			
CONF-930197–		(9. winter workshop on nuclear dynamics; Key West, FL (United States); 30 Jan - 6 feb 1993)			
2	18:25082	*See* DOE/ER/40530–8			
3	18:25093	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93011848	MF-413
CONF-930204–		('93 meeting on waste management; Tucson, AZ (United States); 28 Feb - 4 mar 1993)			
2	18:23060	*See* WHC-SA–1698			
3	18:23068	*See* WHC-SP–1689			
CONF-930205–		(Waste management '93; Tucson, AZ (United States); 28 Feb - 4 mar 1993)			
17	18:22926	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93007862	MF-902
18	18:22911	*See* ANL/CMT/CP–77655			
23	18:22992	*See* LA-UR–93-456			
31	18:23026	*See* PNL-SA–21463			
32	18:23668	*See* PNL-SA–21833			
33	18:23024	*See* PNL-SA–21453			
34	18:24780	*See* PNL-SA–21537			
37	18:23022	*See* PNL-SA–21393			
38	18:23023	*See* PNL-SA–21394			
42	18:23030	*See* PNL-SA–22047			
45	18:24782	*See* PNL-SA–21865			
46	18:23029	*See* PNL-SA–21893			
50	18:23028	*See* PNL-SA–21856			
53	18:22927	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93009726	MF-902
56	18:22920	*See* BNL–48607			
62	18:24172	*See* SAND–92-2236C			
CONF-9302102–		(ANPA WEST 9 conference; Stanford, CA (United States); 13-15 Feb 1993)			
1	18:25001	*See* SLAC-PUB–6057			
CONF-9302106–		(Interagency Advanced Power Group (IAPG) electrical working group meeting; Palo Alto, CA (United States); 10-12 Feb 1993)			
Summ.	18:24489	OSTI; NTIS; GPO Dep.	E 1.99:	DE93010899	MF-220
CONF-9302112–		(Madi Gras conference on concurrent computing in the physical sciences; Baton Rouge, LA (United States); 18-20 Feb 1993)			
1	18:25386	*See* BNL–48759			
2	18:25202	*See* LA-UR–93-1296			
CONF-9302115–		(AGU monograph/solar system plasma physics meeting on resolution of processes in space and time; Yosemite, CA (United States); Feb 1993)			
1	18:24994	*See* LA-UR–93-1241			
3	18:24996	*See* LA-UR–93-1470			
CONF-930235–		(5. annual international superconductor applications conference; San Jose, CA (United States); 1-3 Feb 1993)			
1	18:25224	*See* ANL/MCT/CP–78926			

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CONF-930239–		(We-Heraeus seminar: hadronic processes at small angles in storage rings; Bad Honnef (Germany); 1-3 Feb 1993)			
1	18:25031	*See* BNL–48595			
CONF-930243–		(Data banks for risk assessment workshop; Augusta, GA (United States); 2-3 Feb 1993)			
5	18:25306	*See* EGG-M–92627			
CONF-930245–		(Privacy and Security Research Group workshop on network and distributed systems security; San Diego, CA (United States); 11-12 Feb 1993)			
	18:25388	OSTI; NTIS; GPO Dep.	E 1.99:	DE93010504	MF-700
1	18:25443	*See* UCRL-JC–112301			
CONF-930257–		(3. international symposium of field screening methods for hazardous wastes and toxic chemicals; Las Vegas, NV (United States); 24-26 Feb 1993)			
2	18:24801	*See* UCRL-JC–111786			
CONF-930269–		(Computational accelerator physics conference (CAP93); Pleasanton, CA (United States); 22-26 Feb 1993)			
10	18:24382	*See* SLAC-PUB–6067			
11	18:24381	*See* SLAC-PUB–6061			
12	18:24330	*See* SSCL-Preprint–220			
13	18:24326	*See* SLAC-PUB–6163			
CONF-930270–		(MHD contractor's review meeting; Pittsburgh, PA (United States); 2-4 Feb 1993)			
1	18:23781	*See* ANL/CMT/CP–78930			
CONF-930275–		(RIKEN international workshop on heavy-ion fusion reactors with neutron-rich beams; Saitama (Japan); 18-20 Feb 1993)			
5	18:25062	*See* ANL/PHY/CP–79192			
CONF-930278–		(1993 American Society for Quality Control (ASQC) audit conference; Charlotte, NC (United States); 25-26 Feb 1993)			
4	18:25383	*See* WHC-SA–1783			
CONF-930295–		(6. international environmental and molecular mutagenesis: the molecular basis of chromosomal aberrations; Castlemaine (Australia); 17-20 Feb 1993)			
2	18:24872	*See* BNL–48723			
CONF-930304–		(205. American Chemical Society national meeting; Denver, CO (United States); 28 Mar - 2 apr 1993)			
15	18:22730	*See* PNL-SA–21665			
16	18:22729	*See* PNL-SA–21664			
18	18:24067	*See* DOE/METC/C–93/7065			
19	18:24112	*See* PNL-SA–21663			
CONF-9303103–		(American Society of Mechanical Engineers (ASME) conference on seismic analysis; San Francisco, CA (United States); 22-24 Mar 1993)			
1	18:23363	*See* BNL-NUREG–48448			
CONF-9303107–		(International conference on emerging separation technologies for metals and fuels; Palm Coast, FL (United States); 13-28 Mar 1993)			
1	18:24659	*See* ANL/ES/CP–78514			
CONF-9303108–		(15. national industrial energy technology conference; Houston, TX (United States); 24-25 Mar 1993)			
2	18:23763	*See* PNL-SA–22016			
CONF-9303112–		(American Defense Preparedness Associates symposium on the environment; Albuquerque, NM (United States); 23-25 Mar 1993)			
1	18:24761	*See* LA-UR–93-484			
CONF-9303113–		(Hazmat central conference; Chicago, IL (United States); 9-11 Mar 1993)			
1	18:24935	*See* ANL/ESH/CP–78903			

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CONF-9303119–		(5. short wavelength: physics with intense laser pulses; San Diego, CA (United States); 29-31 Mar 1993)			
2	18:25193	*See* BNL–48940			
CONF-9303122–		(3. ARM science team meeting; Norman, OK (United States); 1-5 Mar 1993)			
1	18:24595	*See* LA-UR–93-857			
2	18:24639	*See* PNL-SA–21966			
CONF-9303127–		(Virtual reality system '93; New York, NY (United States); 15-17 Mar 1993)			
1	18:25446	*See* UCRL-JC–112806			
CONF-9303134–		(9. international conference on advanced science and technology; Schaumburg, IL (United States); 27 Mar 1993)			
1	18:22912	*See* ANL/CMT/CP–79163			
CONF-9303137–		(Interagency Advanced Power Group (IAPG) chemical working group meeting: White Oak, MD (United States); 25 Mar 1993)			
1	18:23694	*See* ANL/CMT/CP–79338			
CONF-930315–		(ECWEC'93. European community wind energy conference and exhibition; Travemuende (Germany); 8-12 Mar 1993)			
	18:23312	*See* Riso-R–683(EN)			
CONF-9303153–		(International thermonuclear experimental reactor meeting; Atlanta, GA (United States); 10 Mar 1993)			
1	18:25293	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013729	MF-420
CONF-9303154–		(Air and waste water management seminar; New Orleans, LA (United States); 9-12 Mar 1993)			
1	18:22756	*See* DOE/MC/24132–93/C0187			
CONF-9303157–		(8. United States-Japan workshop on high-field superconductors Applied Superconducting Center; Madison, WI (United States); 16-19 Mar 1993)			
1	18:25336	*See* UCRL-JC–113199			
CONF-9303164–		(4. annual TOCOM combat vehicle survivability symposium; Gaithersburg, MD (United States); 30 Mar - 1 apr 1993)			
1	18:24493	*See* SAND–92-2515C			
CONF-9303167–		(Along Track Scanning Radiometer (ATSR) science team meeting; Abingdon (United Kingdom); 30 Mar 1993)			
1	18:24810	*See* BNL–48858			
CONF-930318–		(NACE annual corrosion conference and materials performance and corrosion show; New Orleans, LA (United States); 7-12 Mar 1993)			
9	18:23949	*See* PNL-SA–21491			
CONF-930324–		(Symposium on improved technology for fossil power plants: new and retrofit applications; Washington, DC (United States); 1-3 Mar 1993)			
1	18:23352	*See* ANL/EAIS/CP–79050			
CONF-930331–		(6. Society for Industrial and Applied Mathematics (SIAM) conference on parallel processing for scientific computing; Norfolk, VA (United States); 21-24 Mar 1993)			
9	18:25442	*See* UCRL-JC–112022			
10	18:25418	*See* PNL-SA–21790			
CONF-930352–		(2. international conference on nuclear engineering; San Francisco, CA (United States); 21-24 Mar 1993)			
15	18:23456	*See* ANL/FC/CP–77824			
17	18:23645	*See* LA-UR–92-3503			
CONF-930364–		(Spring national meeting of the American Institute of Chemical Engineers; Houston, TX (United States); 28 Mar - 1 apr 1993)			
1	18:22928	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93010831	MF-940
3	18:22659	*See* BNL–48737			

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
CONF-930367–		(Conference on spectroscopies in novel superconductors; Santa Fe, NM (United States); 17-19 Mar 1993)			
4	18:25230	*See* LA-UR–93-1414			
CONF-930371–		(4. annual Walker Branch Watershed research symposium; Oak Ridge, TN (United States); 18-19 Mar 1993)			
Absts.	18:24717	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93009356	MF-402
CONF-930372–		(1993 international simulators conference on high performance computing; Arlington, VA (United States); 29 Mar - 1 apr 1993)			
8	18:24934	*See* ANL/EAIS/CP–79014			
10	18:25285	*See* UCRL-JC–111840			
11	18:25385	*See* ANL/MCS/CP–79562			
CONF-930376–		(International seminar on liquid metal systems: material behavior and physical chemistry in liquid metal systems II; Karlsruhe (Germany); 16-18 Mar 1993)			
1	18:23464	*See* WHC-SA–1682			
CONF-930389–		(Future directions in particle and nuclear physics at multi-GeV hadron beam facilities; Upton, NY (United States); 4-6 Mar 1993)			
3	18:25022	*See* BNL–48760			
5	18:25152	*See* LA-UR–93-1503			
6	18:25020	*See* LA-UR–93-1511			
7	18:25045	*See* LA-UR–93-1502			
8	18:25043	*See* LA-UR–93-1388			
10	18:25046	*See* LA-UR–93-1532			
11	18:25153	*See* LA-UR–93-1625			
CONF-930395–		(Computer simulation in waste management and environmental sciences; Washington, DC (United States); 29 Mar - 1 apr 1993)			
4	18:23061	*See* WHC-SA–1723			
CONF-930396–		(Waste management '93; Tucson, AZ (United States); 1-5 Mar 1993)			
9	18:23106	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93010335	MF-902
10	18:22929	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93010823	MF-407
11	18:23038	*See* SAND–92-1934C			
CONF-930398–		(American Society of Testing and Materials (ASTM) meeting on glass transition; Atlanta, GA (United States); 4-5 Mar 1993)			
2	18:24043	*See* PNL-SA–21812			
CONF-930401–		(Meeting on nuclear plant instrumentation, control and man-machine interface technologies; Oak Ridge, TN (United States); 18-21 Apr 1993)			
11	18:23516	*See* ANL/RA/CP–78880			
13	18:23635	*See* EGG-M–92466			
14	18:23523	*See* EGG-M–92470			
16	18:23517	*See* BNL-NUREG–48669			
CONF-930402–		(4. topical meeting on emergency preparedness and response; Long Island, NY (United States); 25-29 Apr 1993)			
3	18:23131	*See* EGG-M–93031			
5	18:23606	*See* WSRC-MS–92-167-Del.Ver.			
CONF-930403–		(5. topical meeting on robotics and remote systems; Knoxville, TN (United States); 26-29 Apr 1993)			
33	18:24718	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93010340	MF-906
37	18:24144	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93010268	MF-940
39	18:24145	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93010274	MF-906
43	18:23510	*See* ANL/FC/CP–77769			
44	18:24477	*See* ANL/FC/CP–77793			
45	18:22877	*See* ANL/FC/CP–76869			
47	18:22876	*See* ANL/FC/CP–76768			
48	18:24146	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93010334	MF-906; MF-902
49	18:24151	*See* EGG-M–92580			
51	18:24175	*See* SAND–93-0678C			

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CONF-930404–		(International topical meeting on mathematical methods and supercomputing in nuclear applications (M&C+SNA '93); Karlsruhe (Germany); 19-23 Apr 1993)			
	18:23373	*See* CEA-CONF–11278			
	18:23458	*See* CEA-CONF–11279			
	18:23481	*See* CEA-CONF–11276			
	18:23482	*See* CEA-CONF–11277			
	18:25387	*See* CEA-CONF–11246			
13	18:22878	*See* ANL/FC/CP–78468			
14	18:25161	*See* EGG-M–92469			
CONF-930405–		(Spring meeting of the Materials Research Society; San Francisco, CA (United States); 12-16 Apr 1993)			
2	18:24046	*See* SAND–92-2498C			
4	18:24468	*See* ANL/MSD/CP–78008			
6	18:24050	*See* SAND–93-1020C			
9	18:24471	*See* LBL–33982			
CONF-930408–		(International high-level radioactive waste management conference; Las Vegas, NV (United States); 25-29 Apr 1993)			
46	18:22891	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93009721	MF-940
48	18:23004	*See* LBL–33663			
49	18:23002	*See* LBL–33660			
50	18:23000	*See* LBL–33464			
52	18:23003	*See* LBL–33661			
53	18:22998	*See* LBL–32874			
54	18:22914	*See* ANL/EAIS/CP–78642			
60	18:23042	*See* SAND–92-2679C			
62	18:23072	*See* WSRC-MS–93-143			
63	18:23062	*See* WHC-SA–1731			
64	18:23063	*See* WHC-SA–1733			
65	18:23041	*See* SAND–92-2670C			
66	18:23064	*See* WHC-SA–1738			
68	18:23021	*See* PNL-SA–21258			
69	18:22930	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012990	MF-814
70	18:23031	*See* PNL-SA–22264			
72	18:22999	*See* LBL–33447			
CONF-9304103–		(Department of Energy (DOE) compatibility, aging and service life conference; Aiken, SC (United States); 20-22 Apr 1993)			
5	18:23961	*See* WSRC-MS–93-090			
CONF-9304106–		(1993 ASPE spring topical meeting; Tucson, AZ (United States); 13-15 Apr 1993)			
2	18:24162	*See* LA-UR–93-1025			
CONF-9304107–		(1993 quaternary dating field conference; Grants, NM (United States); 27-28 Apr 1993)			
1	18:24957	*See* LA-UR–93-1069			
CONF-9304109–		(SAGEEP '93: symposium on the application of geophysics to environmental and engineering problems; San Diego, CA (United States); 18-21 Apr 1993)			
1	18:24948	*See* ANL/ES/CP–77790			
CONF-9304111–		(Magnetic stripe card technology seminar: CardTech/Secur/Tech; Arlington, VA (United States); 19 Apr 1993)			
2	18:23159	*See* WHC-SA–1870			
CONF-9304112–		(10. topical conference on radio frequency power in plasmas; Boston, MA (United States); 1-3 Apr 1993)			
4	18:25239	*See* GA-A–21254			
5	18:25240	*See* GA-A–21258			
6	18:25294	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013272	MF-420
7	18:25295	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013208	MF-421
8	18:25296	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012964	MF-420
9	18:25297	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012961	MF-421
12	18:25298	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013278	MF-420
CONF-9304113–		(Faraday Division of Royal Society of Chemistry conference on crystal growth; Glasgow (United Kingdom); 14-16 Apr 1993)			
1	18:24090	*See* BNL–48645			

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CONF-9304114--		(Object-oriented numerics conference; Sunriver, OR (United States); 25-27 Apr 1993)			
2	18:25424	*See* SAND-93-0050C			
3	18:25423	*See* SAND-93-0044C			
4	18:25429	*See* SAND-93-0767C			
CONF-9304117--		(International waste management conference; San Juan (Puerto Rico); 28 Apr 1993)			
2	18:24804	*See* WHC-SA-1896			
3	18:23066	*See* WHC-SA-1921			
CONF-9304126--		(3. international conference on dense z-pinches; London (United Kingdom); 19-23 Apr 1993)			
1	18:25273	*See* LA-UR-93-1382			
2	18:25177	*See* LA-UR-93-1408			
3	18:25231	*See* SAND-93-2805C			
6	18:24281	*See* SAND-92-2804C			
7	18:25274	*See* LA-UR-93-1393			
CONF-9304127--		(Southeastern safety and health conference and exhibition; Atlanta, GA (United States); 26-28 Apr 1993)			
1	18:23146	*See* PNL-SA-22020			
CONF-9304128--		(Department of Energy (DOE) radiation protection conference; Las Vegas, NV (United States); 13-15 Apr 1993)			
1	18:24905	*See* PNL-SA-22241			
4	18:23135	*See* LA-UR-93-1366			
7	18:24904	*See* PNL-SA-21972			
8	18:24877	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013522	MF-407
10	18:23065	*See* WHC-SA-1835			
CONF-930413--		(18. international technical conference on coal utilization, slurry technologies and fuel systems; Clearwater, FL (United States); 26-29 Apr 1993)			
1	18:22742	*See* ANL/EAIS/CP-79487			
CONF-9304130--		(The risk assessment paradigm after ten years; Dayton, OH (United States); 5-8 Apr 1993)			
1	18:23766	*See* PNL-SA-22216			
CONF-9304131--		(Advanced Monte Carlo computer programs for radiation transport; Saclay (France); 27-29 Apr 1993)			
1	18:25163	*See* LA-UR-93-1338			
2	18:25164	*See* LA-UR-93-1392			
CONF-9304137--		(Centre d'Etudes meeting; Saclay (France); 27-29 Apr 1993)			
2	18:25157	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013271	
CONF-9304140--		(Workshop on analyzing scalibility of parallel algorithms; Newport Beach, CA (United States); 13 Apr 1993)			
1	18:25431	*See* SAND-93-0955			
CONF-9304145--		(International workshop on low energy muon science (LEMS '93); Santa Fe, NM (United States); 4-8 Apr 1993)			
1	18:25044	*See* LA-UR-93-1471			
CONF-930419--		(International conference on metallurgical coatings and thin films; San Diego, CA (United States); 19-23 Apr 1993)			
1	18:24049	*See* SAND-93-0826C			
CONF-930427--		(4. International Energy Agency heat pump conference: heat pump for energy efficiency and environmental progress; Maastricht (Netherlands); 26-29 Apr 1993)			
2	18:23807	OSTI; NTIS; GPO Dep.	E 1.99:	DE93011856	MF-350
CONF-930433--		(55. annual American power conference; Chicago, IL (United States); 13-15 Apr 1993)			
5	18:23349	*See* ANL/EAIS/CP-78990			
6	18:23457	*See* ANL/OTD-ER/CP-79006			
8	18:23518	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93010308	MF-400

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
CONF-930435–		(SOLAR '93: American Society of Mechanical Engineers (ASME)/American Solar Energy Society (ASES) joint solar energy conference; Washington, DC (United States); 22-28 Apr 1993)			
8	18:23287	*See* NREL/TP–432-5068			
9	18:23288	*See* NREL/TP–471-5099			
CONF-930438–		(95. annual meeting of the American Ceramic Society; Cincinnati, OH (United States); 18-22 Apr 1993)			
4	18:23975	*See* IS-M–744			
5	18:23071	*See* WSRC-MS–92-505			
11	18:23040	*See* SAND–92-2660C			
12	18:22913	*See* ANL/CMT/CP–79523			
15	18:23027	*See* PNL-SA–21559			
17	18:23075	*See* WSRC-MS–93-217			
CONF-930445–		(Society of Photo-Optical Instrumentation Engineers (SPIE) OE/aerospace science and sensing meeting; Orlando, FL (United States); 11-16 Apr 1993)			
1	18:24492	*See* SAND–92-2086C			
9	18:24261	*See* SAND–92-2297C			
11	18:24498	*See* SAND–93-0991C			
12	18:24472	*See* SAND–93-0539C			
13	18:25409	*See* LA-UR–93-1659			
CONF-930482–		(2. international symposium in situ and on-site bioreclamation; San Diego, CA (United States); 5-8 Apr 1993)			
6	18:24783	*See* PNL-SA–22251			
CONF-930483–		(9. waste minimization and pollution prevention conference; San Francisco, CA (United States); 13-15 Apr 1993)			
2	18:22903	*See* SAND–93-0469C			
3	18:24803	*See* WHC-SA–1883			
4	18:23886	*See* SAND–93-1027C			
6	18:23836	*See* KCP–613-5193			
CONF-930491–		(International robots and vision conference; Detroit, MI (United States); 6-8 Apr 1993)			
3	18:24180	*See* UCRL-JC–111218			
CONF-930511–		(International particle accelerator conference; Washington, DC (United States); 17-20 May 1993)			
3	18:24983	*See* SAND–92-2221C			
5	18:24421	*See* SSCL-Preprint–371			
6	18:24372	*See* LA-UR–93-1517			
10	18:24414	*See* SSCL-Preprint–342			
109	18:24417	*See* SSCL-Preprint–358			
11	18:24423	*See* SSCL-Preprint–376			
119	18:24394	*See* SSCL-Preprint–244			
12	18:24422	*See* SSCL-Preprint–373			
123	18:24343	*See* BNL–48230			
13	18:24336	*See* SSCL-Preprint–382			
15	18:24412	*See* SSCL-Preprint–327			
16	18:24307	*See* SSCL-Preprint–389			
17	18:24395	*See* SSCL-Preprint–245			
18	18:24333	*See* SSCL-Preprint–351			
19	18:24413	*See* SSCL-Preprint–333			
20	18:24420	*See* SSCL-Preprint–366			
21	18:24416	*See* SSCL-Preprint–356			
22	18:24401	*See* SSCL-Preprint–277			
23	18:24419	*See* SSCL-Preprint–363			
24	18:24332	*See* SSCL-Preprint–304			
25	18:24411	*See* SSCL-Preprint–326			
26	18:24335	*See* SSCL-Preprint–365			
29	18:24424	*See* SSCL-Preprint–378			
30	18:24306	*See* SSCL-Preprint–375			
33	18:24400	*See* SSCL-Preprint–273			
34	18:24334	*See* SSCL-Preprint–355			
36	18:24331	*See* SSCL-Preprint–299			
41	18:24430	*See* LA-UR–93-1866			
44	18:24374	*See* LA-UR–93-1903			

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47	18:24373	*See* LA-UR–93-1873			
55	18:24415	*See* SSCL-Preprint–349			
64	18:24418	*See* SSCL-Preprint–361			
68	18:24427	*See* UCRL-JC–112342			
78	18:24325	*See* LA-UR–93-1961			
79	18:24410	*See* SSCL-Preprint–320			
80	18:24405	*See* SSCL-Preprint–296			
88	18:24337	*See* SSCL-Preprint–386			
91	18:24305	*See* SSCL-Preprint–323			
CONF-9305110–		(Expo 93; Oak Ridge, TN (United States); May 1993)			
1	18:24484	*See* SAND–92-2623C			
2	18:23155	*See* SAND–92-2781C			
CONF-9305125–		(International workshop on nuclear data for fusion reactor technology; San Diego, CA (United States); 3-6 May 1993)			
1	18:25086	*See* ANL/EP/CP–79504			
CONF-930513–		(Annual conference and exhibition of the Society of Tribologists and Lubrication Engineers; Calgary (Canada); 17-20 May 1993)			
2	18:23966	OSTI; NTIS; GPO Dep.	E 1.99:	DE93010337	MF-330
CONF-9305135–		(7. annual conference on fossil energy materials; Oak Ridge, TN (United States); 11-13 May 1993)			
1	18:23914	*See* ANL/MCT/CP–79046			
2	18:23327	*See* ANL/MCT/CP–79047			
3	18:23986	*See* ANL/MCT/CP–79029			
Absts.	18:23913	*See* ORNL/M–2788			
CONF-9305140–		(8. international workshop on water waves and floating bodies; Newfoundland (Canada); 23-26 May 1993)			
1	18:24828	*See* LA-UR–93-507			
CONF-9305151–		(15. computer security group training conference: mission possible - connected and protected; Albuquerque, NM (United States); 3-6 May 1993)			
	18:25389	OSTI; NTIS; GPO Dep.	E 1.99:	DE93011853	MF-905
1	18:25394	*See* EGG–10617-6097			
2	18:25428	*See* SAND–93-0742C			
5	18:25430	*See* SAND–93-0908C			
CONF-9305153–		(Association for Computing Machinery (ACM) symposium on the theory of computing; San Diego, CA (United States); May 1993)			
3	18:25422	*See* SAND–92-2585C			
CONF-9305159–		(Optical Society of America (OSA) topical meeting on soft x-ray projection lithography; Monterey, CA (United States); 10-12 May 1993)			
2	18:25166	*See* SAND–93-0901C			
CONF-9305166–		(American Filtration Society seminar and expo annual meeting; Chicago, IL (United States); 3-6 May 1993)			
1	18:24838	*See* WSRC-MS–92-479			
CONF-9305168–		(Application Visualization System (AVS) '93 users group meeting; Orlando, FL (United States); 24-26 May 1993)			
2	18:24762	*See* LA-UR–93-1200			
CONF-9305169–		(Stanford exploration project program review; Stanford, CA (United States); 17-21 May 1993)			
1	18:24466	*See* UCRL-JC–113380			
CONF-9305171–		(Computational accelerator particle conference; Washington, DC (United States); 17-20 May 1993)			
1	18:24389	*See* SSCL-Preprint–219			
CONF-9305176–		(Rapid prototyping and manufacturing '93 conference and exhibits; Dearborn, MI (United States); 10-13 May 1993)			
1	18:24176	*See* SAND–93-0931C			

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CONF-9305177–		(12. International collaboration of advanced neutron sources meeting (ICANS); Abingdon (United Kingdom); 24-28 May 1993)			
1	18:24448	*See* LA-UR–93-1389			
2	18:25215	*See* LA-UR–93-1519			
6	18:24375	*See* LA-UR–93-1947			
CONF-9305180–		(FG&G cadet conference; Idaho Falls, ID (United States); 13-14 May 1993)			
1	18:23034	*See* RFP–4611			
CONF-9305183–		(EPRI workshop; Scottsdale, AZ (United States); 19-22 May 1993)			
1	18:24641	*See* SAND–93-8558C			
CONF-9305186–		(7. international conference on solid state sensors and actuators; No City Given (Japan); 13-15 May 1993)			
1	18:24285	*See* SAND–93-1006C			
CONF-9305188–		(1993 annual meeting of the American Crystallographic Association (ACA); Albuquerque, NM (United States); 24-28 May 1993)			
1	18:23985	*See* ANL/MCT/CP–78715			
CONF-9305189–		(1993 joint Army, Navy, NASA, Air Force (JANNAF) Propulsion Systems Hazards Subcommittee meeting; Ft. Lewis, WA (United States); 10-14 May 1993)			
2	18:24526	*See* SAND–93-1091C			
CONF-9305191–		(3. Nuclear simulation Symposium and mathematical modeling workshop; Schliersee (Germany); 17-19 May 1993)			
	18:23374	*See* CEA-CONF–11280			
CONF-9305197–		(International symposium on microgravity science and application; Beijing (China); 10-13 May 1993)			
1	18:25000	*See* LBL–33995			
CONF-9305198–		(8. Scandanavian conference on image analysis; Tromso (Norway); 25-28 May 1993)			
1	18:24147	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013280	MF-400
CONF-930521–		(12. international conference on fluidized-bed combustion; San Diego, CA (United States); 8-13 May 1993)			
7	18:22760	*See* DOE/MC/27364–93/C0186			
CONF-930523–		(18. National Association of Environmental Professionals (NAEP) annual conference on current and future priorities for environmental management; Raleigh, NC (United States); 24-26 May 1993)			
1	18:22995	*See* LA-UR–93-998			
2	18:24719	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93009663	MF-402
3	18:23843	OSTI; NTIS; GPO Dep.	E 1.99:	DE93011862	MF-249
6	18:23743	*See* WHC-SA–1690			
CONF-930533–		(15. annual symposium of the European Safeguards Research and Development Association: safeguards and nuclear materials management; Rome (Italy); 11-13 May 1993)			
1	18:23895	*See* SAND–93-1125C			
3	18:23762	*See* SAND–93-1152C			
CONF-930537–		(5. annual international industrial symposium on the Super Collider and exhibition; San Francisco, CA (United States); 6-8 May 1993)			
2	18:24385	*See* SSCL-Preprint–208			
3	18:24388	*See* SSCL-Preprint–216			
4	18:24390	*See* SSCL-Preprint–226			
5	18:25054	*See* SSCL-Preprint–241			
6	18:24387	*See* SSCL-Preprint–215			
7	18:24392	*See* SSCL-Preprint–235			
10	18:24384	*See* SSCL-Preprint–203			
11	18:24386	*See* SSCL-Preprint–210			
13	18:24399	*See* SSCL-Preprint–264			
14	18:24396	*See* SSCL-Preprint–260			
17	18:24462	*See* SSCL-Preprint–258			
19	18:24397	*See* SSCL-Preprint–262			
20	18:24398	*See* SSCL-Preprint–263			

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21	18:24409	*See* SSCL-Preprint–318			
22	18:24407	*See* SSCL-Preprint–309			
23	18:24404	*See* SSCL-Preprint–282			
24	18:24403	*See* SSCL-Preprint–280			
25	18:24402	*See* SSCL-Preprint–279			
34	18:24393	*See* SSCL-Preprint–237			
36	18:24391	*See* SSCL-Preprint–228			
43	18:24406	*See* SSCL-Preprint–305			
46	18:24408	*See* SSCL-Preprint–311			
8-Rev.1	18:24329	*See* SSCL-Preprint–149-Rev.1			
CONF-930544–		(Conference on polarized ion sources and polarized gas targets; Madison, WI (United States); 23-27 May 1993)			
1	18:24376	*See* LA-UR–93-2040			
CONF-930561–		(39. international instrumentation symposium; Albuquerque, NM (United States); 2-6 May 1993)			
4	18:24000	OSTI; NTIS; GPO Dep.	E 1.99:	DE93010830	MF-406
CONF-930571–		(183. Electrochemical Society meeting; Honolulu, HI (United States); 16-21 May 1993)			
7	18:22994	*See* LA-UR–93-697			
11	18:24089	*See* ANL/MSD/CP–77829			
12	18:23693	*See* UCRL-JC–112177			
14	18:24035	*See* LA-UR–93-1618			
CONF-930572–		(12. annual international symposium on thermal treatment technologies - incineration conference; Knoxville, TN (United States); 3-7 May 1993)			
2	18:23070	*See* WSRC-MS–92-430			
CONF-930585–		(2. USA/CIS joint conference on environmental hydrology and hydrogeology; Washington, DC (United States); 16-29 May 1993)			
2	18:24658	*See* ANL/ER/CP–77595			
CONF-930586–		(Quantum electronics and laser science conference; Baltimore, MD (United States); 2-7 May 1993)			
5	18:24056	*See* UCRL-JC–112312			
CONF-930601–		(American Nuclear Society (ANS) annual meeting; San Diego, CA (United States); 20-24 Jun 1993)			
11	18:23680	*See* WSRC-MS–92-292			
14	18:24185	*See* Y/DD–588			
16	18:23725	*See* ANL/EAIS/CP–78705			
17	18:23621	*See* ANL/RE/CP–78569			
CONF-930605–		(Safewaste '93: the final disposal of nuclear waste; Avignon (France); 14-18 Jun 1993)			
2	18:22907	*See* WHC-SA–1867			
1-Rev.1	18:23069	*See* WSRC-MS–91-104-Rev.1			
CONF-9306129–		(13. international symposium on nonlinear acoustics; Bergen (Norway); 28 Jun - 2 jul 1993)			
1	18:24956	*See* LA-UR–93-856			
CONF-9306130–		(National thermal spray conference; Anaheim, CA (United States); 7-11 Jun 1993)			
2	18:23934	*See* EGG-M–92715			
3	18:23924	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013803	MF-406
CONF-9306142–		(2. international conference on mathematical and numerical aspects of wave propagation (SIAM); Newark, DE (United States); 7-10 Jun 1993)			
1	18:24964	*See* UCRL-JC–112052			
CONF-9306143–		(Energy Facility Contractors Group safety analysis meeting; Denver, CO (United States); 16-18 Jun 1993)			
1	18:23149	*See* WSRC-MS–93-146			
3	18:24914	*See* WSRC-MS–93-067			
CONF-9306145–		(8. international conference on vehicle structural mechanics and computer-aided engineering; Traverse City, MI (United States); 3-5 Jun 1993)			
1	18:25420	*See* SAND–91-2016C			

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CONF-9306149–		(CED international nuclear accident dosimeter intercomparison conference; Dijon (France); 7-8 Jun 1993)			
1	18:23185	*See* WSRC-MS–93-148			
CONF-930615–		(Biennial conference on carbon; Buffalo, NY (United States); 13-18 Jun 1993)			
1	18:24048	*See* SAND–93-0825C			
CONF-9306150–		(5. international conference of the Groupe de Travail de Pyrotechnie; Strasbourg (France); Jun 1993)			
1	18:24525	*See* SAND–93-0757C			
CONF-9306151–		(7. international symposium on methodologies for intelligent systems; Trondheim (Norway); 15-18 Jun 1993)			
	18:25417	*See* ORNL/TM–12375			
CONF-9306153–		(7. International Association for Mathematical and Computers in Simulation (IMACS) conference on computer methods for partial differential equations; New Brunswick, NJ (United States); 22-24 Jun 1993)			
1	18:24250	*See* LBL–32529			
CONF-9306157–		(Parallel I/O and databases symposium; Hanover, NH (United States); 21-30 Jun 1993)			
1	18:25432	*See* SAND–93-0956C			
CONF-9306158–		(1993 groundwater modeling conference; Boulder, CO (United States); 6-12 Jun 1993)			
3	18:23073	*See* WSRC-MS–93-204			
CONF-9306159–		(1993 Society of Women Engineers (SWE) conference; Chicago, IL (United States); 21-27 Jun 1993)			
1	18:23819	*See* SAND–92-2270C			
CONF-9306160–		(6. international conference on soil dynamics and earthquake engineering; Bath (United Kingdom); 14-16 Jun 1993)			
1	18:24181	*See* UCRL-JC–112894			
CONF-9306164–		(Conference on electron microscopy; Lund (Sweden); 9-11 Jun 1993)			
1	18:24084	*See* LBL–33753			
CONF-9306165–		(Multiphase flow problems in manufacturing and productive technology; Bethesda, MD (United States); Jun 1993)			
-1	18:23933	*See* EGG-M–92696			
CONF-9306167–		(Joint AIRAPT/APS meeting; Colorado Springs, CO (United States); 28 Jun - 3 jul 1993)			
4	18:23942	*See* LA-UR–93-1670			
CONF-930644–		(34. US symposium on rock mechanics; Madison, WI (United States); 27-30 Jun 1993)			
5	18:24963	*See* UCRL-JC–111981			
5-Rev.1	18:24962	*See* UCRL-JC–111977-Rev.1			
CONF-930647–		(86. annual meeting and exhibition of the Air and Waste Management Association; Denver, CO (United States); 13-18 Jun 1993)			
4	18:24186	*See* Y/DV–1191			
CONF-930667–		(International conference on inverse problems in engineering: theory and practice; Palm Coast, FL (United States); 13-18 Jun 1993)			
1	18:24837	*See* WSRC-MS–92-473			
CONF-930701–		(6. international conference on indoor air quality and climate; Helsinki (Finland); 4-8 Jul 1993)			
2	18:24576	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93010278	MF-402
3	18:24720	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93010277	MF-402
CONF-930702–		(Pressure vessel and piping conference; Denver, CO (United States); 25-29 Jul 1993)			
12	18:23381	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93009709	
13	18:24057	*See* WSRC-MS–93-135			
14	18:23925	OSTI; NTIS; GPO Dep.	E 1.99:	DE93011849	MF-404
18	18:23960	*See* WSRC-MS–93-037			
20	18:22906	*See* WHC-SA–1414			

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CONF-930713–		(10. detonation symposium; Boston, MA (United States); 12-16 Jul 1993)			
6	18:24521	*See* LA-UR–93-1119			
9	18:24522	*See* LA-UR–93-1180			
10	18:24523	*See* LA-UR–93-1557			
CONF-930736–		(1993 Institute of Electrical and Electronics Engineers/Robotics Society of Japan (IEEE/RSJ) international conference on intelligent robots and systems (IROS); Yokohama (Japan); 26-30 Jul 1993)			
2	18:24174	*See* SAND–93-0588C			
CONF-930745–		(1. international conference in intelligent systems for molecular biology; Washington, DC (United States); 7-9 Jul 1993)			
1	18:24852	*See* LA-UR–93-1647			
CONF-930758–		(9. international conference on composite materials; Madrid (Spain); 12-16 Jul 1993)			
1	18:24447	*See* LA-UR–93-1162			
CONF-930765–		(SCSC '93: summer computer simulation conference; Boston, MA (United States); 19-21 Jul 1993)			
2	18:24495	*See* SAND–92-2845C			
CONF-930768–		(3. annual international symposium of the National Council on Systems Engineering; Arlington, VA (United States); 26-28 Jul 1993)			
1	18:25381	*See* POEF-T–3605			
CONF-930769–		(1993 joint Canadian Society of Civil Engineers-American Society of Civil Engineers (CSCE-ASCE) national conference on environmental engineering; Montreal (Canada); 12-14 Jul 1993)			
1	18:24721	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93011847	MF-403
3	18:23107	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012753	MF-700
4	18:24664	*See* BNL–48908			
CONF-930770–		(Workshop on algorithms and data structures; International congress on automata and language processing; Montreal (Canada); Lund (Sweden); 11-13 Aug 1993; jul 1993)			
1	18:25426	*See* SAND–93-0689C			
CONF-930773–		(9. international conference on systems engineering (ICSE '93); Las Vegas, NV (United States); 14-16 Jul 1993)			
1	18:25441	*See* UCRL-JC–112016			
CONF-930778–		(1993 RELAP5 international users meeting; Boston, MA (United States); 6-9 Jul 1993)			
1	18:23612	*See* WSRC-MS–92-519			
CONF-930779–		(International cosmic-ray conference; Calgary (Canada); 19-20 Jul 1993)			
5	18:24997	*See* LA-UR–93-1605			
6	18:24998	*See* LA-UR–93-1608			
8	18:24995	*See* LA-UR–93-1286			
9	18:24999	*See* LA-UR–93-1609			
12	18:25079	*See* LBL–33959			
13	18:25070	*See* LBL–33903			
CONF-930780–		(National conference of standards laboratories; Albuquerque, NM (United States); 25 Jul 1993)			
1	18:24483	*See* RFP–4693			
CONF-930783–		(27. Microbeam Analysis Society meeting; Los Angeles, CA (United States); 11-16 Jul 1993)			
1	18:23967	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013207	MF-404
CONF-930801–		(Conference of the International Union of Pure and Applied Physics on low temperature physics (LT 20); Eugene, OR (United States); 1-11 Aug 1993)			
1	18:24982	*See* LA-UR–93-1420			
CONF-930802–		(206. American Chemical Society national meeting; Chicago, IL (United States); 22-27 Aug 1993)			
1	18:22692	OSTI; NTIS; GPO Dep.	E 1.99:	DE93011858	MF-401

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CONF-930803--		(12. biennial conference for the International Association for Structural Mechanics in Reactor Technology; Stuttgart (Germany); 16-20 Aug 1993)			
1	18:23679	*See* WSRC-MS-92-262			
2	18:23646	*See* LA-UR-93-268			
3	18:23647	*See* LA-UR-93-269			
4	18:23491	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93009713	
5	18:23492	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93009714	
6	18:23673	*See* SAND-93-0592C			
7	18:23674	*See* SAND-93-0593C			
8	18:23549	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93011863	MF-1030
9	18:23507	*See* SAND-92-2074C			
10	18:23629	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013511	
11	18:23494	*See* EGG-M-92476			
CONF-930804--		(28. intersociety energy conversion engineering conference; Atlanta, GA (United States); 8-13 Aug 1993)			
2	18:23791	*See* LA-UR-93-1689			
CONF-9308105--		(8. international symposium on high voltage engineering; Yokohama (Japan); 23-27 Aug 1993)			
1	18:24925	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013210	MF-408
CONF-930815--		(International biohydrometallurgy symposium; Jackson Hole, WY (United States); 22-25 Aug 1993)			
1	18:23935	*See* EGG-M-93104			
CONF-930821--		(9. international symposium on environmental degradation of materials in nuclear power systems; St. Louis, MO (United States); Aug 1993)			
1	18:24109	*See* KAPL-4735			
CONF-930822--		(Annual meeting of the Electron Microscopy Society of America; Cincinnati, OH (United States); 1-6 Aug 1993)			
1	18:25217	*See* SAND-93-0812C			
2	18:24087	*See* SAND-93-0813C			
3	18:25209	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013205	MF-406
4	18:24001	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012969	MF-404
5	18:23968	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012759	MF-364
CONF-930830--		(National conference and exposition on heat transfer; Atlanta, GA (United States); 8-11 Aug 1993)			
1	18:23608	*See* WSRC-MS-92-362			
2	18:23609	*See* WSRC-MS-92-388			
3	18:23362	*See* BNL-NUREG-48415			
4	18:24161	*See* LA-UR-93-197			
5	18:23678	*See* WSRC-MS-91-531			
6	18:23550	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93008274	MF-406
7	18:23630	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93008267	MF-523
8	18:23684	*See* WSRC-MS-92-406			
9	18:23682	*See* WSRC-MS-92-366			
10	18:23683	*See* WSRC-MS-92-368			
11	18:24055	*See* UCRL-JC-111969			
12	18:23610	*See* WSRC-MS-92-390			
13	18:23272	*See* SAND-92-2346C			
14	18:23268	*See* SAND-93-0023C			
15	18:23681	*See* WSRC-MS-92-365			
16	18:24137	*See* SAND-93-0106C			
19	18:23631	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013531	MF-400
CONF-930848--		(13. international joint conference on artificial intelligence; Chambery, Savoie (France); 29 Aug - 3 sep 1993)			
1	18:25408	*See* LA-UR-92-3770			
CONF-930850--		(25. annual meeting of the International Metallographic Society (IMS); Denver, CO (United States); 2-5 Aug 1993)			
1	18:23611	*See* WSRC-MS-92-441			

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CONF-930861–		(American Institute of Aeronautics and Astronautics (AIAA) guidance, navigation, and control conference; Monterey, CA (United States); 9-11 Aug 1993)			
1	18:24494	*See* SAND–92-2716C			
CONF-930862–		(1993 American Society of Mechanical Engineers (ASME) international computers in engineering conference and exposition; San Diego, CA (United States); 8-12 Aug 1993)			
1	18:23083	*See* WSRC-TR–93-010			
2	18:24173	*See* SAND–92-2405C			
CONF-930866–		(12. international conference on noise in physical systems and 1/f fluctuations; St. Louis, MO (United States); 16-20 Aug 1993)			
1	18:24283	*See* SAND–93-0037C			
CONF-930870–		(Waterpower '93; Nashville, TN (United States); 10-13 Aug 1993)			
1	18:23220	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93008578	MF-402; MF-408
CONF-930873–		(2. international mixed waste symposium; Baltimore, MD (United States); 17-20 Aug 1993)			
8	18:22996	*See* LA-UR–93-1197			
9	18:22997	*See* LA-UR–93-1204			
13	18:23074	*See* WSRC-MS–93-207			
CONF-930880–		(International conference on the physics of semiconductors; Beijing (China); 10-14 Aug 1993)			
1	18:24047	*See* SAND–93-0609C			
2	18:24045	*See* SAND–92-0825C			
3	18:24044	*See* SAND–92-0824C			
CONF-930881–		(Siggraph '93 conference; Anaheim, CA (United States); 2-6 Aug 1993)			
1	18:25444	*See* UCRL-JC–112597			
2	18:25445	*See* UCRL-JC–112601			
CONF-930884–		(Workshop on algorithms and data structures; International congress on automata and language processing; Montreal (Canada); Lund (Sweden); 11-13 Aug 1993; jul 1993)			
1	18:25426	*See* SAND–93-0689C			
2	18:25427	*See* SAND–93-0690C			
CONF-930889–		(2. U.S. National Congress on Computational Mechanics meeting; Washington, DC (United States); 16-18 Aug 1993)			
1	18:23037	*See* SAND–92-1537C			
CONF-930898–		(4. international conference on concurrency theory; Hildesheim (Germany); 23-26 Aug 1993)			
1	18:25448	*See* UCRL-JC–113531			
CORR–					
83-0124-Del.Ver.	18:22931	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93009747	MF-700
CRN–					
92-32	18:25095	OSTI; NTIS (US Sales Only); INIS		DE93626932	
92-51	18:25096	OSTI; NTIS (US Sales Only); INIS		DE93626899	
DL-SCI-TM–					
88-E	18:25390	OSTI; NTIS (US Sales Only); INIS		DE93626602	
DNA-TR–					
92-131	18:24558	OSTI; NTIS		DE93013096	
DOE–					
76-45/6-Rev.1	18:23699	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013700	MF-607
DOE-HMIP-RR–					
92.099	18:22945	OSTI; NTIS (US Sales Only); INIS		DE93626424	
92.118	18:22946	OSTI; NTIS (US Sales Only); INIS		DE93626425	
DOE-RAS–					
92.001	18:24881	OSTI; NTIS (US Sales Only); INIS		DE93624586	
92.002	18:24882	OSTI; NTIS (US Sales Only); INIS		DE93624587	
92.003	18:22954	OSTI; NTIS (US Sales Only); INIS		DE93626426	
92.004	18:24816	OSTI; NTIS (US Sales Only); INIS		DE93625634	
92.005	18:24817	OSTI; NTIS (US Sales Only); INIS		DE93625635	
92.006	18:23539	OSTI; NTIS (US Sales Only); INIS		DE93625789	
92.007	18:24738	OSTI; NTIS (US Sales Only); INIS		DE93625615	
92.008	18:24818	OSTI; NTIS (US Sales Only); INIS		DE93624537	
92.009	18:24069	OSTI; NTIS (US Sales Only); INIS		DE93624271	
92.015	18:24819	OSTI; NTIS (US Sales Only); INIS		DE93624538	

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
DOE-STD–					
1021-93	18:23703	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015087	MF-500
1031-92	18:23704	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014732	MF-500
1032-92	18:23705	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014733	MF-500
1033-92	18:23706	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014817	MF-500
1034-93	18:23707	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014734	MF-500
1035-93	18:23708	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014735	MF-500
1039-93	18:23709	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014736	MF-500
1050-93	18:23755	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014266	MF-500
1051-93	18:23756	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013951	MF-500
1052-93	18:23757	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014267	MF-500
1053-93	18:23758	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014268	MF-500
1054-93	18:23759	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013952	MF-500
1055-93	18:23760	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013953	MF-500
1056-93	18:23710	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012878	MF-500
1057-93	18:23711	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012980	MF-500
1058-93	18:23712	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012982	MF-500
1059-93	18:23713	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012981	MF-500
1060-93	18:23714	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012979	MF-500
1061-93	18:23715	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013954	MF-500
DOE/AD–					
0009	18:23700	OSTI; NTIS; GPO Dep.	E 1.99:	DE93011822	MF-900
DOE/AN/ACNT–					
92C	18:23890	OSTI; NTIS; GPO Dep.	E 1.99:	DE93010998	MF-900
DOE/BC/14246–					
11	18:22790	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000140	PC-122
DOE/BC/14425–					
T13-App.1-Vol.1	18:22776	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014666	MF-122
T13-App.1-Vol.4	18:22777	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014669	MF-122
DOE/BC/14472–					
11	18:22791	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014191	MF-122
DOE/BC/14657–					
12	18:22792	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014539	MF-122
DOE/BC/14852–					
2	18:22793	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014533	MF-122
DOE/BC/14853–					
3	18:22831	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014642	MF-122
DOE/BC/14860–					
1	18:22794	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014610	MF-122
DOE/BC/14864–					
1	18:22795	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014608	MF-122
DOE/BC/14881–					
2	18:22796	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014532	MF-122
DOE/BC/14882–					
2	18:22797	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014531	MF-122
DOE/BC/14884–					
1	18:22798	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014741	MF-113
DOE/BC/14886–					
2	18:22799	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014538	MF-122
DOE/BC/14951–					
1	18:22800	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014607	MF-122
DOE/BC/14952–					
2	18:22801	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014609	MF-122
DOE/BC/14958–					
2	18:22802	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014543	MF-122
DOE/BC/14959–					
2	18:22803	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014530	MF-122
DOE/BP–					
00425-2	18:23298	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012371	MF-920
07129-3	18:23301	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93011648	MF-900
1909	18:23217	OSTI; NTIS; GPO Dep.	E 1.99:	DE93011649	MF-902
2013	18:23299	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012375	MF-251
2014	18:23300	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012373	MF-251
2015	18:23295	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012372	MF-920
2017	18:23834	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012370	MF-920
DOE/CE/15382–					
T2	18:23808	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013234	MF-350
DOE/CE/15407–					
T13	18:23809	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013327	MF-350
DOE/CE/15492–					
T4	18:23926	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014434	MF-313

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
DOE/CE/15553–					
T3	18:22804	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015355	MF-250
DOE/CE/23810–					
6	18:24002	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014766	MF-350
7	18:23810	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014767	MF-350
11	18:24004	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014770	MF-366
11A	18:24005	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014771	MF-366
11B	18:24006	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014772	MF-366
11C	18:24007	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014773	MF-366
11D	18:24008	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014774	MF-366
8C	18:24003	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014768	MF-366
DOE/CE/26602–					
1	18:23844	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013298	MF-350
2	18:23845	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013299	MF-350
3	18:23846	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013300	MF-350
4	18:23847	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013301	MF-350
DOE/CE/40777–					
9	18:24257	OSTI; NTIS; GPO Dep.	E 1.99:	DE93010635	MF-310
10	18:24431	OSTI; NTIS; GPO Dep.	E 1.99:	DE93010636	MF-310
DOE/CE/40860–					
1	18:23328	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014858	MF-317
DOE/CE/50337–					
T1	18:23867	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014395	MF-333
DOE/CE/90053–					
T44	18:23701	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013702	MF-220
T47	18:23780	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014558	MF-220
DOE/CH–					
9217	18:23108	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93011566	MF-400; MF-402
DOE/CH/10093–					
182	18:23296	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000024	MF-250
210	18:23258	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000093	MF-270
DOE/DP–					
0110P	18:25299	OSTI; NTIS; GPO Dep.	E 1.99:	DE93007431	MF-700
DOE/DP/00789–					
T268	18:22932	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012199	MF-721
T273	18:22933	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012204	MF-721
T274	18:22934	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012205	MF-721
T275	18:22935	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012206	MF-721
T276	18:22936	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012207	MF-721
T278	18:22937	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012209	MF-721
T280	18:22938	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012211	MF-721
T281	18:22939	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012212	MF-721
T285	18:22940	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012216	MF-721
T287	18:22941	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012218	MF-721
DOE/EH–					
0258T-1	18:23109	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014777	MF-607
0258T-2	18:23110	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014778	MF-607
0259T-1	18:23111	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014779	MF-607
0259T-2	18:23112	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014780	MF-607
0260T-1	18:23113	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014781	MF-607
0260T-2	18:23114	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014782	MF-607
0261T-1	18:23115	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014783	MF-607
0261T-2	18:23116	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014784	MF-607
0262T-1	18:23117	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014785	MF-607
0262T-2	18:23118	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014786	MF-607
0262T-3	18:23119	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014787	MF-607
0262T-4	18:23120	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014788	MF-607
0262T-5	18:23121	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014789	MF-607
0262T-6	18:23122	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014790	MF-607
0262T-7	18:23123	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014791	MF-607
0262T-8	18:23124	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014792	MF-607
0262T-9	18:23125	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014793	MF-607
0262T-10	18:23126	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014794	MF-607
0316	18:25300	OSTI; NTIS; GPO Dep.	E 1.99:	DE93011223	MF-630
93012807	18:23734	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012807	MF-600
DOE/EIA–					
0109(93/04)	18:22832	OSTI; NTIS; GPO; GPO Dep.	E 1.99:	DE93013203	MF-950
0130(93/04)	18:22833	OSTI; NTIS; GPO; GPO Dep.	E 1.99:	DE93012896	MF-950
0437(91)/2	18:23702	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93011468	MF-950
0520(93/04)	18:22834	OSTI; NTIS; GPO; GPO Dep.	E 1.99:	DE93013129	MF-950

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
DOE/ER–					
0313/13	18:25301	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013462	PC-423; PC-424
0536	18:25391	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013813	MF-405
0586T	18:24577	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012765	PC-402
0588	18:24578	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013736	MF-402
DOE/ER/01067–					
18	18:25055	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013263	MF-413
DOE/ER/12120–					
1	18:23169	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015933	MF-420
DOE/ER/12813–					
T1	18:24240	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93011399	MF-413
T2	18:24241	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93011769	MF-413
DOE/ER/13188–					
8	18:23259	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015558	MF-408
DOE/ER/13191–					
13	18:25173	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012970	MF-411
DOE/ER/13255–					
9	18:23195	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014842	MF-408
DOE/ER/13357–					
22	18:24063	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015526	MF-401
DOE/ER/13361–					
T4	18:24866	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014837	MF-408
DOE/ER/13370–					
T2	18:23196	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014433	MF-408
DOE/ER/13439–					
8	18:24116	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015078	MF-401
DOE/ER/13456–					
50	18:25174	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93008474	MF-411
DOE/ER/13530–					
5	18:24984	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013249	MF-403
DOE/ER/13560–					
7	18:23969	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013978	MF-404
DOE/ER/13641–					
7	18:24242	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015563	MF-406
DOE/ER/13711–					
T2	18:22778	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015091	MF-403
DOE/ER/13717–					
3	18:23197	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015740	MF-408
DOE/ER/13726–					
6	18:24985	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013145	MF-410
DOE/ER/13734–					
4	18:24840	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014398	MF-408
DOE/ER/13740–					
10	18:24986	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014437	MF-410
DOE/ER/13810–					
6	18:24841	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015589	MF-408
DOE/ER/13878–					
5	18:24134	OSTI; NTIS; GPO Dep.	E 1.99:	DE93016050	MF-401
DOE/ER/13906–					
5	18:23970	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015881	MF-401
DOE/ER/13909–					
3	18:24842	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013987	MF-408
DOE/ER/13970–					
4	18:24843	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015582	MF-408
DOE/ER/13971–					
20	18:25183	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013863	MF-411
DOE/ER/13978–					
4	18:24950	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015093	MF-403
DOE/ER/13991–					
1	18:24243	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013537	MF-406
DOE/ER/14024–					
4	18:24117	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013981	MF-401
DOE/ER/14056–					
14	18:24844	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015208	MF-401
DOE/ER/14062–					
3	18:24009	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013985	MF-404
DOE/ER/14065–					
T1	18:24095	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013590	MF-403
DOE/ER/14156–					
2	18:24118	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015559	MF-401

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
DOE/ER/14181–1	18:25200	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015560	MF-401
DOE/ER/14182–2	18:24244	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012806	MF-411
DOE/ER/14187–1	18:24064	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014648	MF-401
DOE/ER/14213–1	18:25232	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014098	MF-412
DOE/ER/14263–1	18:25184	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012110	MF-406
DOE/ER/14280–1	18:24096	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015500	MF-401
DOE/ER/14281–1	18:24097	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015622	MF-401
DOE/ER/14289–1	18:24098	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015932	MF-401
DOE/ER/14301–1	18:24099	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015070	MF-401
DOE/ER/20050–2	18:24845	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015098	MF-408
T1	18:24846	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015885	MF-408
DOE/ER/25019–T1	18:24966	OSTI; NTIS; GPO Dep.	E 1.99:	DE93010959	MF-405
DOE/ER/25047–5	18:25392	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015310	MF-405
DOE/ER/25136–1	18:25393	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015357	MF-405
DOE/ER/30196–3	18:24722	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013259	MF-402
DOE/ER/40159–199	18:25067	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013376	MF-413
DOE/ER/40249–T1	18:25009	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93011912	MF-414
DOE/ER/40272–182	18:25023	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93011589	MF-414
DOE/ER/40293–7	18:25097	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013868	MF-413
DOE/ER/40321–8	18:25098	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013383	MF-413
10	18:25099	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013384	MF-413
11	18:25100	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013385	MF-413
DOE/ER/40333–136	18:25233	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93010252	MF-414
137	18:25158	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93010253	MF-414
138	18:25159	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93010254	MF-414
DOE/ER/40427–21-N92	18:25073	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93010201	MF-413
32-N92	18:25014	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93010199	MF-413
36-N92	18:25015	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93011003	MF-413
DOE/ER/40437–4	18:25081	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013861	MF-414
DOE/ER/40530–8	18:25082	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93011272	MF-413
DOE/ER/40561–080	18:25101	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93010569	MF-413
098	18:25024	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93011005	MF-413
DOE/ER/40637–6	18:25102	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014844	MF-414
DOE/ER/40643–2	18:23927	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013980	MF-414
DOE/ER/40646–3	18:25035	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013326	MF-414
DOE/ER/40660–1	18:24436	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014097	MF-414
DOE/ER/40672–2	18:25010	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013971	MF-414
DOE/ER/40681–2	18:25011	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013336	MF-414
DOE/ER/40731–1	18:24294	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014087	MF-414

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
DOE/ER/45125–10	18:24010	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015076	MF-411
DOE/ER/45133–5	18:25201	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015095	MF-404
DOE/ER/45147–8	18:23971	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014441	MF-404
DOE/ER/45163–33	18:25210	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014847	MF-404
DOE/ER/45205–8	18:24011	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013977	MF-404
DOE/ER/45228–65	18:23972	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014959	MF-404
DOE/ER/45233–8	18:25211	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015079	MF-411
DOE/ER/45316–T1	18:25175	OSTI; NTIS; GPO Dep.	E 1.99:	DE93016142	MF-410
DOE/ER/45359–2	18:23973	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015066	MF-404
DOE/ER/45401–4	18:23928	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014526	MF-401
DOE/ER/45403–4	18:23929	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014840	MF-404
DOE/ER/45406–1	18:25223	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013972	MF-405
DOE/ER/45413–3	18:23974	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014707	MF-404
DOE/ER/53098–T9	18:25302	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015611	MF-427
DOE/ER/53198–218	18:25234	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013464	PC-426
DOE/ER/53212–212	18:25235	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013466	PC-427
DOE/ER/54134–2	18:23930	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015073	MF-420
DOE/ER/60247–T4	18:24723	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013241	MF-402
DOE/ER/60372–8	18:24579	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013982	MF-402
DOE/ER/60487–7	18:24856	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014435	MF-408
DOE/ER/60539–11	18:24878	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015580	MF-408
DOE/ER/60547–5	18:23811	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013976	MF-402; MF-407
DOE/ER/60561–8	18:24857	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014439	MF-408
DOE/ER/60572–T2	18:24926	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015089	MF-402
DOE/ER/60692–5	18:24850	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015072	MF-408
DOE/ER/60727–T1	18:24724	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012037	MF-408
T2	18:24725	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012038	MF-408
DOE/ER/60847–T1	18:24726	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013223	MF-403
DOE/ER/60851–4	18:24851	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015094	MF-408
DOE/ER/60964–4	18:24927	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015097	MF-408
DOE/ER/60977–4	18:24727	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013374	MF-402
DOE/ER/60991–T1	18:24728	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015561	MF-408
T2	18:24729	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015562	MF-408
DOE/ER/61033–3	18:24858	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015356	MF-404
DOE/ER/61417–1	18:24580	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015060	MF-408
DOE/ER/61438–T1	18:24815	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014282	MF-408

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
DOE/ER/61484–					
5	18:24730	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013295	MF-408
DOE/ER/75582–					
T1	18:24065	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015068	MF-401
DOE/ER/75728–					
1	18:23551	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012987	MF-400
DOE/ER/75729–					
1	18:23552	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012808	MF-400
DOE/ET/53088–					
599	18:25236	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012191	MF-420
DOE/FTR–					
4349	18:24847	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93012772	MF-408
93010184	18:23467	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93010184	MF-744
93010290	18:24140	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93010290	MF-706
93010294	18:23086	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93010294	MF-702
93010924	18:23931	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93010924	MF-706
93011413	18:24859	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93011413	MF-414
93011416	18:24120	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93011416	MF-706
93011425	18:24951	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93011425	MF-700
93011427	18:23745	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93011427	MF-700
93011550	18:24148	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93011550	MF-706
93011663	18:24879	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93011663	MF-408
93011813	18:24245	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93011813	MF-406
93011935	18:24346	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93011935	MF-700
93011936	18:23284	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93011936	MF-233
93012115	18:22693	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93012115	MF-108
93012118	18:25303	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93012118	MF-414
93012145	18:22892	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93012145	MF-722
93012146	18:24012	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93012146	MF-414
93012250	18:25012	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93012250	MF-414
93012254	18:23190	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93012254	MF-247
93012360	18:22942	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93012360	MF-902
93012551	18:23932	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93012551	MF-312
93012813	18:23812	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93012813	MF-350
93012814	18:24149	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93012814	MF-721
93012817	18:24987	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93012817	MF-412
93012926	18:22943	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93012926	MF-721
93012977	18:25304	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93012977	MF-700
93012984	18:23186	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93012984	MF-920
93012986	18:23910	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93012986	MF-700
93013012	18:24880	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93013012	MF-408
93013018	18:22752	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93013018	MF-104
93013019	18:24469	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93013019	MF-700
93013395	18:24013	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93013395	MF-700
93013409	18:22880	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93013409	MF-526
93013411	18:24975	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93013411	MF-406
93013526	18:25056	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93013526	MF-413
93013553	18:25305	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93013553	MF-420
93013555	18:22753	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93013555	MF-310
93013556	18:25074	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93013556	MF-413
93013557	18:24267	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93013557	MF-336
93013558	18:22944	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93013558	MF-940
93013655	18:25212	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93013655	MF-706
93013656	18:25228	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93013656	MF-420
93013657	18:24014	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93013657	MF-706
DOE/ID–					
10217(93)	18:23748	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012172	MF-500
10415	18:22947	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012171	MF-940
10423	18:22881	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012141	MF-524
DOE/ID/12691–					
T5	18:24066	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014838	MF-310
DOE/ID/13167–					
T2	18:24731	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015092	MF-900
DOE/LLW–					
160	18:22893	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012176	MF-820
162	18:22948	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012170	MF-900
166	18:22949	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013696	MF-940
172	18:22950	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013738	MF-940
DOE/MC/10637–					
3313	18:22754	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000253	MF-103

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
DOE/MC/11076–					
3338	18:23835	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000275	PC-123
DOE/MC/11089–					
3318	18:22860	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000254	MF-123
DOE/MC/20422–					
3319	18:22852	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000255	PC-132
DOE/MC/23166–					
3320	18:22755	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000256	PC-111
DOE/MC/24116–					
3363	18:22694	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013989	MF-109
DOE/MC/24132–					
3359	18:22757	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014529	MF-103
93/C0187	18:22756	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012830	MF-103
DOE/MC/24258–					
3362	18:22758	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013993	MF-105
DOE/MC/24267–					
3327	18:22695	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000264	PC-109
3329	18:22696	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000266	MF-109
DOE/MC/25045–					
3342	18:22861	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93000279	PC-123
DOE/MC/25048–					
3102	18:22759	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000274	PC-103
3353	18:24246	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013360	MF-103
DOE/MC/25141–					
3339	18:22697	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000276	PC-111
3340	18:22698	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000277	PC-111
DOE/MC/25168–					
3291	18:23790	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000248	PC-110
DOE/MC/26031–					
11	18:22805	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014517	MF-122
DOE/MC/27225–					
3344	18:23213	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013990	MF-132
DOE/MC/27364–					
93/C0186	18:22760	OSTI; NTIS; GPO Dep.	E 1.99:	DE93011584	MF-103
DOE/MC/27401–					
3332	18:22863	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000269	PC-104; PC-123
DOE/MC/29116–					
3355	18:24581	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014093	MF-115
DOE/MC/29234–					
3364	18:23329	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000280	PC-111
DOE/METC/C–					
93/7062	18:22761	OSTI; NTIS; GPO Dep.	E 1.99:	DE93011586	MF-104
93/7065	18:24067	OSTI; NTIS; GPO Dep.	E 1.99:	DE93011587	MF-115
DOE/MT/92001–					
3	18:22842	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014606	MF-122
DOE/MT/92007–					
2	18:22838	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014604	MF-122
DOE/MT/92008–					
1	18:22839	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014602	MF-122
2	18:22840	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014603	MF-122
DOE/MT/92009–					
T1	18:22841	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014508	MF-122
DOE/MT/92012–					
3	18:22846	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014605	MF-122
DOE/NV/10649–					
T1	18:23868	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013778	MF-335
DOE/NV/10845–					
T11	18:24732	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015315	MF-702
T12	18:24733	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015316	MF-702
T13	18:24734	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015317	MF-702
T14	18:24735	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015318	MF-702
T15	18:24736	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93015319	MF-702
T16	18:24737	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015591	MF-703
T8	18:23718	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013965	MF-703
DOE/NV/10872–					
8	18:22951	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014228	MF-814
T53	18:24247	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014239	MF-814
T55	18:22952	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014241	MF-814
DOE/OR–					
01-1100-D3	18:22953	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013251	MF-902

DOE/OR–

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01-1115-D1	18:23127	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93011835	MF-702
DOE/OR/00033–					
T528	18:25343	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013318	MF-700
DOE/PC/79660–					
T10	18:22762	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013059	PC-104
DOE/PC/88940–					
T14	18:22699	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014936	PC-108
DOE/PC/89781–					
12	18:22700	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014978	MF-102
13	18:22701	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014973	MF-105
DOE/PC/89784–					
T2	18:24100	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014856	PC-105
DOE/PC/89786–					
T16	18:23214	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014951	MF-108
DOE/PC/89788–					
T12	18:22702	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014969	MF-108
DOE/PC/89879–					
T13	18:22703	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014940	MF-108
DOE/PC/89908–					
T29	18:22650	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014953	MF-102
DOE/PC/90035–					
T2	18:24101	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015779	MF-102
T6	18:24102	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015775	MF-113
DOE/PC/90043–					
T8	18:23215	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014952	MF-108
DOE/PC/90044–					
7	18:22704	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013524	MF-109
DOE/PC/90181–					
T8	18:24479	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013071	MF-115
DOE/PC/90184–					
T10	18:24248	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014955	MF-113
DOE/PC/90284–					
10	18:22735	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014975	MF-113
DOE/PC/90292–					
T10	18:23334	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014965	MF-105
DOE/PC/90310–					
T11	18:22763	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014943	MF-113
DOE/PC/90361–					
T9	18:23335	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014961	MF-105
DOE/PC/90364–					
T6	18:23336	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014939	PC-105
DOE/PC/90366–					
T6	18:23337	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014954	MF-104
DOE/PC/90537–					
T2	18:22705	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015629	MF-108
T3	18:22706	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015628	MF-108
T4	18:22707	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015627	MF-108
T5	18:22708	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015626	MF-108
T6	18:22709	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015625	MF-108
T7	18:22710	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015624	MF-108
T8	18:22711	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015623	MF-108
DOE/PC/90544–					
T6	18:23338	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014937	PC-105
DOE/PC/90547–					
T10	18:22764	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014514	MF-105
DOE/PC/91041–					
T6	18:22712	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014515	MF-108
DOE/PC/91042–					
T4	18:22713	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014941	MF-108
DOE/PC/91043–					
T6	18:22714	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014942	MF-108
DOE/PC/91050–					
T1	18:22715	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015054	MF-108
T2	18:22716	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015064	MF-108
DOE/PC/91054–					
T5	18:22717	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014946	MF-108
DOE/PC/91059–					
T4	18:22718	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014950	MF-108
DOE/PC/91281–					
T5	18:22719	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014948	MF-108

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DOE/PC/91284–					
2	18:22765	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014957	MF-105
5	18:23339	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014977	MF-113
DOE/PC/91289–					
T6	18:22720	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014944	MF-102
DOE/PC/91290–					
T5	18:22651	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014970	MF-102
DOE/PC/91292–					
T6	18:22766	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014516	MF-104
DOE/PC/91302–					
6	18:22736	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014519	MF-113
DOE/PC/91305–					
5	18:22737	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014518	MF-102
DOE/PC/91306–					
6	18:24103	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014974	MF-105
DOE/PC/91344–					
T3	18:23340	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014971	MF-105
DOE/PC/91345–					
T8	18:23341	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014956	MF-105
DOE/PC/91346–					
1	18:23342	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015057	MF-105
DOE/PC/92111–					
T2	18:22857	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014962	MF-125
DOE/PC/92118–					
T1	18:24104	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015055	MF-108
DOE/PC/92205–					
T2	18:22652	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014972	MF-102
DOE/PC/92207–					
T1	18:22653	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015051	MF-102
DOE/PC/92521–					
T13	18:22722	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013632	MF-105; MF-109
T19	18:22723	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013638	MF-105
T2	18:22740	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013620	MF-105
T28	18:22738	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013647	MF-105
T29	18:24105	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013648	MF-105
T3	18:22741	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013621	MF-105
T30	18:22724	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013649	MF-105
T31	18:24470	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013650	MF-105
T32	18:22725	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013652	MF-105
T33	18:24068	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013653	MF-105
T4	18:22767	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013622	MF-105
T7	18:22721	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013626	MF-105
DOE/PC/92527–					
T2	18:22726	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014966	MF-108
DOE/PC/92531–					
T1	18:22727	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015056	MF-113
DOE/PC/92532–					
T3	18:24106	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014963	MF-108
DOE/PC/92543–					
T2	18:22654	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014968	MF-102
DOE/PC/92544–					
2	18:22739	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014958	MF-113
DOE/PC/92547–					
2	18:22655	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014976	MF-102
DOE/PC/92548–					
T1	18:22768	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015053	MF-105
DOE/PC/92550–					
2	18:22656	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015063	MF-102
DOE/PE/79065–					
T1	18:23716	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93005123	MF-900
DOE/RL–					
91-39-Rev.1A	18:22955	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012618	MF-721
92-51	18:22956	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012617	MF-902
DOE/RW–					
0345P	18:22957	OSTI (Free of Charge); INIS		TI93013686	MF-814
0410	18:22958	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012192	MF-800
0411	18:22959	OSTI (Free of Charge); INIS		TI93013735	MF-800
0416	18:22960	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013733	MF-800
DOE/SF/18852–					
T25	18:23183	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93011911	MF-528

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
DOE/SR/15191–					
6	18:24739	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015583	MF-702
7	18:24740	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015564	MF-702
DOE/SR/18159–					
2	18:24741	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015621	MF-403
DOE/SR/18217–					
1	18:24883	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014442	MF-600
DOE/SR/18271–					
1	18:24742	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015592	MF-704
DOE/UMTRA–					
050506-Vol.5	18:23128	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012927	MF-902
DOE/WIPP–					
89-011-Rev.1	18:22961	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012198	MF-721
89-022-Rev.1	18:22962	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012197	MF-721
DPSP–					
55-454-5	18:23129	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93012789	MF-700
DPSPU–					
74-124-6-Rev.1	18:24150	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013685	MF-722
DPSTSA–					
200-10-Suppl.-18-Del.Ver.	18:22963	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93009745	MF-702
200-10-Suppl.5-Del.Ver.	18:23130	OSTI; NTIS; GPO Dep.	E 1.99:	DE93009881	MF-702
DPW–					
3637	18:22964	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93011160	MF-700
3652	18:22882	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93012048	MF-721
3694	18:23560	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93011170	MF-700
3720	18:23561	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93011177	MF-706
3816	18:23562	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93010105	MF-700
3909	18:23563	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93011148	MF-700
3989	18:23564	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93011153	MF-700
3990	18:23540	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93011144	MF-700
4148	18:23565	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93011139	MF-700
4295	18:23566	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93011155	MF-700
4300	18:22965	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93011154	MF-700
4408	18:23541	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93011126	MF-700
4461	18:25454	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93011156	MF-700
4466	18:23188	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93011157	MF-700
4489	18:23567	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93011159	MF-700
4785	18:23520	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93011191	MF-706
4836	18:23568	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93011204	MF-700
4851	18:23569	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93011203	MF-700
4864	18:23521	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93011202	MF-700
4906	18:23570	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93011200	MF-700
4908	18:23571	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93011201	MF-700
53-1232	18:23558	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93008317	MF-700
53-1238	18:23519	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93008318	MF-700
53-1430	18:23559	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93010101	MF-700
53-3-1	18:23553	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93012040	MF-706
53-3-3	18:23554	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93012041	MF-706
53-3-4	18:23555	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93012042	MF-700
53-3-5	18:23556	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93012043	MF-706
53-3-6	18:23493	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93012044	MF-706
53-3-8	18:22874	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93012045	MF-706
53-3-10	18:22875	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93012046	MF-700
53-3-11	18:23557	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93012047	MF-704
DTP–					
92/80.	18:25030	*See* RAL–92-078			
DUN–					
3259	18:23542	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93012155	MF-700
4977	18:23575	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93012157	MF-700
5566-3	18:23576	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93012058	MF-700
5566-4	18:23577	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93012059	MF-700
6205	18:24820	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93012158	MF-701
6463	18:23578	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93012061	MF-711
6476	18:23579	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93012062	MF-711
7162	18:24821	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93012159	MF-701
7166	18:23580	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93012063	MF-711
7253	18:23581	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93012160	MF-700
7377	18:23594	*See* HW-SA–7377			
7521	18:23543	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93012064	MF-711

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850-1	18:23572	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93012051	MF-700
850-2	18:23573	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93012052	MF-700
850-3	18:23574	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93012053	MF-700
ECN-RX–					
92-040	18:25160	OSTI; NTIS; INIS		DE93626951	
92-064	18:25103	OSTI; NTIS; INIS		DE93626881	
92-066	18:25083	OSTI; NTIS; INIS		DE93626845	
EDF–					
93-NJ-00002	18:23522	OSTI; NTIS (US Sales Only); INIS		DE93626238	
EEV–					
93-01	18:23310	OSTI; NTIS		DE93794762	
EGG–					
101617-2164	18:24839	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013403	
10617-1227	18:24582	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93008084	MF-702
10617-2187	18:24743	OSTI; NTIS; GPO Dep.	E 1.99:	DE93007553	MF-702
10617-6097	18:25394	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012130	MF-706
2635-Vol.3	18:23370	*See* NUREG/CR–5672-Vol.3			
2683	18:23632	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012142	MF-940
2688	18:23661	*See* NUREG/CR–5937			
2694	18:23662	*See* NUREG/CR–5976			
2697	18:23664	*See* NUREG/CR–6027			
EGG-CODP–					
10620(3-93)	18:25395	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012169	MF-505
EGG-EP–					
10715	18:23848	OSTI; NTIS; GPO Dep.	E 1.99:	DE93011851	PC-249
9831	18:23869	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013588	MF-333
EGG-ESQ–					
10614	18:24744	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93010756	MF-902
EGG-GEO–					
10304-Vol.2	18:23633	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93012264	MF-903
EGG-LLW–					
9525	18:22966	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93011395	MF-512
EGG-M–					
92069	18:24268	OSTI; NTIS; GPO Dep.	E 1.99:	DE93010804	MF-310
92256	18:23634	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93010801	MF-520
92413	18:23468	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93013672	MF-522
92417	18:24517	OSTI; NTIS; GPO Dep.	E 1.99:	DE93010622	MF-906
92466	18:23635	OSTI; NTIS; GPO Dep.	E 1.99:	DE93010788	
92469	18:25161	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93010796	MF-500
92470	18:23523	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93010789	MF-500
92476	18:23494	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013680	
92502	18:23469	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93010791	MF-506
92569	18:23636	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93010792	MF-506
92571	18:24942	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013669	MF-907
92580	18:24151	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93010803	MF-940
92595	18:25396	OSTI; NTIS; GPO Dep.	E 1.99:	DE93010802	MF-500
92627	18:25306	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93010807	MF-420
92648	18:25068	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93010790	MF-500
92696	18:23933	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013671	MF-310
92715	18:23934	OSTI; NTIS; GPO Dep.	E 1.99:	DE93010797	MF-310
93031	18:23131	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93010806	MF-610
93104	18:23935	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013676	MF-401; MF-408
EGG-MS–					
10441	18:23936	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012186	
EGG-NE–					
10391	18:23470	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012165	MF-940
EGG-NRE–					
10735	18:23582	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013741	MF-500; MF-520
EGG-RAAM–					
10669	18:23382	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013699	
EGG-WM–					
10533	18:22968	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012189	MF-940
10630	18:22969	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012166	MF-902
9185-Rev.1	18:22967	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93011396	MF-512
EGG-WTD–					
10507	18:24070	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012185	MF-906
10539	18:22970	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012167	MF-902; MF-907
10610	18:22971	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012188	MF-940

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10612	18:22972	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012182	MF-902
10635	18:24152	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012183	MF-906
10674	18:22973	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012184	MF-906
EML–					
549	18:24583	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93008849	MF-402
EMO–					
1096-Vol.1	18:24745	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93011968	
1096-Vol.3	18:24746	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93011970	
1096-Vol.4	18:24747	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93011971	
ENEA-RT-INN–					
92-04	18:24274	OSTI; NTIS (US Sales Only)		DE93000814	
EPRI-TR–					
102106	18:23531	*See* NUREG/CR–6018			
ERA-NRE–					
93-022	18:23583	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013682	MF-520
ERC–					
91-22.	18:22954	*See* DOE-RAS–92.003			
ES/ER/TM–					
55	18:24748	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93011693	MF-902
60	18:22974	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93010559	MF-902
61	18:25344	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93010833	MF-902
62	18:24584	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93011828	MF-902
ESG–					
198	18:24377	*See* LBL–32480			
ESTSC–					
000337C017500	18:25397	ESTSC			
000581IBMPC00	18:25398	ESTSC			
000583I037000	18:25399	ESTSC			
000584IBMPC00	18:25400	ESTSC			
ESTSC/NRC/R–					
000003IBMPC03	18:25401	ESTSC			
ETDE-mf–					
93792318	18:23260	OSTI; NTIS (US Sales Only)		DE93792318	
93792551	18:24585	OSTI; NTIS (US Sales Only)		DE93792551	
93792573	18:24586	OSTI; NTIS (US Sales Only)		DE93792573	
93792574	18:23717	OSTI; NTIS (US Sales Only)		DE93792574	
93792708	18:24822	OSTI; NTIS (US Sales Only)		DE93792708	
93792750	18:23938	OSTI; NTIS (US Sales Only)		DE93792750	
93795223	18:23206	OSTI; NTIS (US Sales Only)		DE93795223	
93795279	18:24587	OSTI; NTIS (US Sales Only)		DE93795279	
93795280	18:24929	OSTI; NTIS (US Sales Only)		DE93795280	
93795282	18:24588	OSTI; NTIS (US Sales Only)		DE93795282	
93795284	18:24589	OSTI; NTIS (US Sales Only)		DE93795284	
93795285	18:24590	OSTI; NTIS (US Sales Only)		DE93795285	
93795286	18:24591	OSTI; NTIS (US Sales Only)		DE93795286	
93795636	18:23764	OSTI; NTIS (US Sales Only)		DE93795636	
93795644	18:22747	OSTI; NTIS (US Sales Only)		DE93795644	
93796884	18:22657	OSTI; NTIS (US Sales Only)		DE93796884	
93796945	18:24592	OSTI; NTIS (US Sales Only)		DE93796945	
ETDE/ES-mf–					
93796608	18:24848	OSTI; NTIS		DE93796608	
93796609	18:24849	OSTI; NTIS		DE93796609	
93796610	18:24928	OSTI; NTIS		DE93796610	
ETDE/JP-mf–					
93793769	18:22771	OSTI; NTIS; Available from The Institute of Energy Economics, Dai 10 Mori Biru, 18-1, Toranomon 1-chome, Minato-ku, Tokyo, Japan		DE93793769	
93793770	18:23719	OSTI; NTIS; Available from The Institute of Energy Economics, Dai 10 Mori Biru, 18-1, Toranomon 1-chome, Minato-ku, Tokyo,Japan		DE93793770	
93794512	18:22835	OSTI; NTIS; Available from Japan National Oil Corp., 2-2, Uchisaiwaicho 2-chome, Chiyoda-ku, Tokyo, Japan		DE93794512	
EUR–					
14366	18:22975	OSTI; NTIS (US Sales Only); INIS		TI93626418	
14466	18:22976	OSTI; NTIS (US Sales Only); INIS		TI93626419	
14497	18:24153	OSTI; NTIS (US Sales Only); INIS		TI93626128	
14715	18:23735	OSTI; NTIS (US Sales Only); INIS		TI93625884	
14755	18:25345	OSTI; NTIS (US Sales Only); INIS		TI93626609	

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FE-MIT–					
92111-2	18:22857	*See* DOE/PC/92111–T2			
FEI–					
2075	18:23511	OSTI; NTIS (US Sales Only); INIS		DE93626230	
2093	18:23512	OSTI; NTIS (US Sales Only); INIS		DE93626231	
2113	18:23524	OSTI; NTIS (US Sales Only); INIS		DE93626239	
2114	18:23584	OSTI; NTIS (US Sales Only); INIS		DE93626299	
2140	18:23459	OSTI; NTIS (US Sales Only); INIS		DE93626296	
2151	18:23460	OSTI; NTIS (US Sales Only); INIS		DE93627421	
2166	18:23495	OSTI; NTIS (US Sales Only); INIS		DE93626215	
2173	18:25195	OSTI; NTIS (US Sales Only); INIS		DE93627003	
2183	18:23480	OSTI; NTIS (US Sales Only); INIS		DE93626232	
2184	18:23483	OSTI; NTIS (US Sales Only); INIS		DE93626212	
FEMP–					
2270	18:24593	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012894	MF-702; MF-707
93010810	18:23132	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93010810	MF-902; MF-903
FNAL/C–					
92-239	18:24347	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013567	MF-414
92/308	18:24348	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014030	MF-414
92/313-A	18:24988	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014008	MF-414
92/389	18:24313	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93011640	MF-414
93/043-E	18:24437	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93011658	MF-414
93/047/E	18:25036	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012778	MF-414
93/051-E	18:25037	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014027	MF-414
93/053-E	18:24438	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013566	MF-414
93/054-E	18:25051	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014028	MF-414
93/077	18:24860	OSTI; NTIS; GPO Dep.	E 1.99:	DE93011887	MF-407
FNAL/Pub–					
93/057-A	18:24989	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012533	MF-414
FRCEA-TH–					
378	18:25213	OSTI; NTIS (US Sales Only); INIS		DE93627278	
FRNC-TH–					
3726	18:25214	OSTI; NTIS (US Sales Only); INIS		DE93627279	
FhG-IWM-Z–					
5/90	18:24015	OSTI; NTIS (US Sales Only)		DE93795318	
GA-A–					
21046	18:25237	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013028	MF-420
21128	18:25238	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012829	MF-420
21236	18:24277	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012153	PC-406
21254	18:25239	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012775	MF-426
21258	18:25240	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012831	MF-421
GANIL-P–					
93-03	18:25104	OSTI; NTIS (US Sales Only); INIS		DE93626900	
GBHW–					
93013128	18:22820	OSTI; Grigoryan Branched-Horizontal Wells Co., 1637 N. Vine St., Suite 916, Los Angeles, CA 90028		TI93013128	
GI–					
91-75	18:24984	*See* DOE/ER/13530–5			
GKSS–					
92/E/16	18:23939	OSTI; NTIS (US Sales Only)		DE93792034	
92/E/48	18:24823	OSTI; NTIS (US Sales Only)		DE93792032	
92/E/49	18:24824	OSTI; NTIS (US Sales Only)		DE93792031	
92/E/50	18:24825	OSTI; NTIS (US Sales Only)		DE93792030	
92/E/51	18:24594	OSTI; NTIS (US Sales Only)		DE93792029	
GSF–					
10/92	18:25455	OSTI; NTIS (US Sales Only)		DE93792033	
23/90	18:22977	OSTI; NTIS (US Sales Only); INIS		DE93792549	
33/91	18:23544	OSTI; NTIS (US Sales Only); INIS		DE93795220	
GSF-TL–					
14/90	18:22977	*See* GSF–23/90			
HAN–					
54065	18:23585	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93012060	MF-700
58378-Del.	18:23586	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93012065	MF-700
HW–					
37945	18:23588	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93010545	MF-520
43332	18:22883	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93012368	MF-711
44097	18:23589	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93012067	MF-700
55819	18:23590	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93009990	MF-520

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
55862	18:23591	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93012068	MF-700
7-2172	18:23587	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93012066	MF-700
72383	18:23592	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93012069	MF-700
77683	18:23593	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93010555	MF-520
79228	18:23637	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93012369	MF-520
HW-SA–					
7377	18:23594	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93012071	MF-711
IAEA-CN–					
56/A-6-3	18:25279	*See* PPPL–2891			
56/A-III-4	18:25281	*See* PPPL–2896			
56/E-2-2	18:25278	*See* PPPL–2890			
56/E-2-4	18:25237	*See* GA-A–21046			
IAEA-CPE–					
92/01	18:25346	OSTI; NTIS (US Sales Only); INIS		DE93624728	
IAEA-CPS–					
92/01	18:25347	OSTI; NTIS (US Sales Only); INIS		DE93624729	
92/02	18:25348	OSTI; NTIS (US Sales Only); INIS		DE93624730	
92/03	18:25349	OSTI; NTIS (US Sales Only); INIS		DE93624731	
92/04	18:25350	OSTI; NTIS (US Sales Only); INIS		DE93624732	
92/05	18:25351	OSTI; NTIS (US Sales Only); INIS		DE93624733	
92/06	18:25352	OSTI; NTIS (US Sales Only); INIS		DE93624734	
92/07	18:25353	OSTI; NTIS (US Sales Only); INIS		DE93624735	
92/08	18:25354	OSTI; NTIS (US Sales Only); INIS		DE93624736	
92/09	18:25355	OSTI; NTIS (US Sales Only); INIS		DE93624737	
92/10	18:25356	OSTI; NTIS (US Sales Only); INIS		DE93624738	
92/11	18:25357	OSTI; NTIS (US Sales Only); INIS		DE93624739	
92/12	18:25358	OSTI; NTIS (US Sales Only); INIS		DE93624740	
92/13	18:25359	OSTI; NTIS (US Sales Only); INIS		DE93624741	
92/14	18:25360	OSTI; NTIS (US Sales Only); INIS		DE93624742	
92/15	18:25361	OSTI; NTIS (US Sales Only); INIS		DE93624743	
92/16	18:25362	OSTI; NTIS (US Sales Only); INIS		DE93624744	
92/17	18:25363	OSTI; NTIS (US Sales Only); INIS		DE93624745	
92/18	18:25364	OSTI; NTIS (US Sales Only); INIS		DE93624746	
92/19	18:25365	OSTI; NTIS (US Sales Only); INIS		DE93624747	
92/20	18:25366	OSTI; NTIS (US Sales Only); INIS		DE93624748	
92/21	18:25367	OSTI; NTIS (US Sales Only); INIS		DE93624749	
92/22	18:25368	OSTI; NTIS (US Sales Only); INIS		DE93624750	
92/23	18:25369	OSTI; NTIS (US Sales Only); INIS		DE93624751	
92/24	18:25370	OSTI; NTIS (US Sales Only); INIS		DE93624752	
92/25	18:25371	OSTI; NTIS (US Sales Only); INIS		DE93624753	
92/26	18:25372	OSTI; NTIS (US Sales Only); INIS		DE93624754	
IAEA-SE–					
92/01	18:25373	OSTI; NTIS (US Sales Only); INIS		DE93624755	
92/02	18:25374	OSTI; NTIS (US Sales Only); INIS		DE93624756	
IAEA-TC-PM–					
003	18:24868	OSTI; NTIS (US Sales Only); INIS		DE93625781	
004	18:25375	OSTI; NTIS (US Sales Only); INIS		DE93626610	
005	18:25376	OSTI; NTIS (US Sales Only); INIS		DE93626611	
IAEA-TECDOC–					
683	18:24071	OSTI; NTIS (US Sales Only); INIS		DE93625117	
690	18:24016	OSTI; NTIS (US Sales Only); INIS		DE93625195	
IAEA/UNDP–					
CPR-85/085-TR	18:25377	OSTI; NTIS (US Sales Only); INIS		DE93626612	
IC–					
93/65	18:25402	OSTI; NTIS (US Sales Only); INIS		DE93624727	
IEN-DQUI-DIAPQ–					
001/86	18:24077	OSTI; NTIS (US Sales Only); INIS		DE93624294	
IEN-DQUI-DISIS–					
001/86	18:24078	OSTI; NTIS (US Sales Only); INIS		DE93624295	
002/86	18:24079	OSTI; NTIS (US Sales Only); INIS		DE93624296	
IFP–					
40394-1	18:22836	OSTI; NTIS (US Sales Only); INIS		DE93626477	
40394-2	18:22837	OSTI; NTIS (US Sales Only); INIS		DE93626478	
IFVE-OEF–					
90-81.	18:24350	*See* IHEP-OEF–90-81			
90-88	18:24439	OSTI; NTIS (US Sales Only); INIS		DE93626355	
IFVE-OKU–					
90-83	18:24314	OSTI; NTIS (US Sales Only); INIS		DE93626147	
IFVE-OLU–					
90-131	18:24349	OSTI; NTIS (US Sales Only); INIS		DE93626165	

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IFVE-OMVT–					
90-75	18:25038	OSTI; NTIS (US Sales Only); INIS		DE93626707	
IFVE-OP–					
91-31	18:25220	OSTI; NTIS (US Sales Only); INIS		DE93627307	
IFVE-OUNK–					
89-223.	18:25221	*See* IHEP-OUNK–89-223			
IHEP-OEF–					
90-81	18:24350	OSTI; NTIS (US Sales Only); INIS		DE93626176	
IHEP-OUNK–					
89-223	18:25221	OSTI; NTIS (US Sales Only); INIS		DE93627308	
INDC(NDS)–					
202/GA	18:25241	OSTI; NTIS (US Sales Only); INIS		DE93626599	
203/GZ	18:24861	OSTI; NTIS (US Sales Only); INIS		DE93626071	
204/GSp	18:25457	OSTI; NTIS (US Sales Only); INIS		DE93626597	
205/GSp	18:25108	OSTI; NTIS (US Sales Only); INIS		DE93626882	
210/GA	18:25247	OSTI; NTIS (US Sales Only); INIS		DE93627108	
211/GA	18:25250	OSTI; NTIS (US Sales Only); INIS		DE93627109	
213/GM3	18:25057	OSTI; NTIS (US Sales Only); INIS		DE93626092	
216/GZ	18:24862	OSTI; NTIS (US Sales Only); INIS		DE93626072	
217/GZ	18:25187	OSTI; NTIS (US Sales Only); INIS		DE93626073	
225/MS	18:25251	OSTI; NTIS (US Sales Only); INIS		DE93627110	
236/M5	18:25256	OSTI; NTIS (US Sales Only); INIS		DE93624938	
237/M6	18:25307	OSTI; NTIS (US Sales Only); INIS		DE93627134	
253/N2	18:25257	OSTI; NTIS (US Sales Only); INIS		DE93626995	
254	18:25259	OSTI; NTIS (US Sales Only); INIS		DE93626996	
255	18:25261	OSTI; NTIS (US Sales Only); INIS		DE93627111	
256/S	18:25120	OSTI; NTIS (US Sales Only); INIS		DE93626883	
257/N8	18:25262	OSTI; NTIS (US Sales Only); INIS		DE93627112	
261/GSp	18:25121	OSTI; NTIS (US Sales Only); INIS		DE93626933	
262/GNC	18:25464	OSTI; NTIS (US Sales Only); INIS		DE93626598	
263/GSp	18:25124	OSTI; NTIS (US Sales Only); INIS		DE93626884	
264/G	18:25308	OSTI; NTIS (US Sales Only); INIS		DE93627252	
265/G	18:25137	OSTI; NTIS (US Sales Only); INIS		DE93626885	
INEL/MISC–					
92154	18:22948	*See* DOE/LLW–162			
92172	18:23748	*See* DOE/ID–10217(93)			
93014	18:22947	*See* DOE/ID–10415			
93016	18:22893	*See* DOE/LLW–160			
INIS-BR–					
3127	18:25378	OSTI; NTIS (US Sales Only); INIS		DE93624758	
INIS-CL–					
004	18:24107	OSTI; NTIS (US Sales Only); INIS		DE93625290	
INIS-XN–					
436	18:23160	OSTI; NTIS (US Sales Only); INIS		DE93626595	
437	18:23161	OSTI; NTIS (US Sales Only); INIS		DE93626585	
438	18:25476	OSTI; NTIS (US Sales Only); INIS		DE93626593	
439	18:23162	OSTI; NTIS (US Sales Only); INIS		DE93626590	
440	18:23163	OSTI; NTIS (US Sales Only); INIS		DE93626591	
441	18:23164	OSTI; NTIS (US Sales Only); INIS		DE93626586	
442	18:23165	OSTI; NTIS (US Sales Only); INIS		DE93626587	
443	18:23166	OSTI; NTIS (US Sales Only); INIS		DE93626588	
444	18:23167	OSTI; NTIS (US Sales Only); INIS		DE93626592	
445	18:23168	OSTI; NTIS (US Sales Only); INIS		DE93626589	
INIS-mf–					
13502	18:23638	OSTI; NTIS (US Sales Only); INIS		DE93626240	
13503	18:23396	OSTI; NTIS (US Sales Only); INIS		DE93625345	
13512	18:25267	OSTI; NTIS (US Sales Only); INIS		DE93623062	
13515	18:23720	OSTI; NTIS (US Sales Only); INIS		DE93626450	
13518	18:23087	OSTI; NTIS (US Sales Only); INIS		DE93625342	
13519	18:22743	OSTI; NTIS (US Sales Only); INIS		DE93624591	
13520	18:23888	OSTI; NTIS (US Sales Only); INIS		DE93624714	
14145	18:24890	OSTI; NTIS (US Sales Only); INIS		DE93792710	
14146	18:23640	OSTI; NTIS (US Sales Only); INIS		DE93795324	
14147	18:24891	OSTI; NTIS (US Sales Only); INIS		DE93795221	
IPF–					
91-3	18:25269	OSTI; NTIS (US Sales Only); INIS		DE93795225	
IPNO-DRE–					
92-22	18:25138	OSTI; NTIS (US Sales Only); INIS		DE93626901	
92-31	18:25075	OSTI; NTIS (US Sales Only); INIS		DE93626833	
92-32	18:25139	OSTI; NTIS (US Sales Only); INIS		DE93626902	
92-34	18:25076	OSTI; NTIS (US Sales Only); INIS		DE93626834	

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92-35	18:25140	OSTI; NTIS (US Sales Only); INIS		DE93626903	
92-37	18:25141	OSTI; NTIS (US Sales Only); INIS		DE93626904	
IPNO-T–					
92-02	18:25077	OSTI; NTIS (US Sales Only); INIS		DE93626835	
92-03	18:25142	OSTI; NTIS (US Sales Only); INIS		DE93626905	
IPPCZ–					
323	18:25270	OSTI; NTIS (US Sales Only); INIS		DE93627106	
IS–					
4878	18:23655	*See* NUREG/CR–4273			
5083	18:23503	*See* NUREG/CR–5957			
5094	18:23108	*See* DOE/CH–9217			
5096	18:23133	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93011563	MF-902
IS-M–					
744	18:23975	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93011559	MF-404
746	18:24981	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93011564	MF-401
IS-T–					
1609	18:24033	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013282	MF-401
ISN–					
92-106	18:25039	OSTI; NTIS (US Sales Only); INIS		DE93626720	
ISPO–					
351	18:23893	*See* LA–12546-MS			
JAB–					
10733-TM6	18:24954	OSTI; NTIS; GPO Dep.	E 1.99:	DE93005849	MF-703
JAERI–					
1328	18:22885	OSTI; NTIS; INIS		DE93797595	
JAERI-M–					
92-178	18:25271	OSTI; NTIS; INIS		DE93797464	
92-183	18:25314	OSTI; NTIS; INIS		DE93788399	
92-192	18:24156	OSTI; NTIS; INIS		DE93797510	
92-196	18:23461	OSTI; NTIS; INIS		DE93797512	
92-197	18:24157	OSTI; NTIS; INIS		DE93797511	
92-201	18:23596	OSTI; NTIS; INIS		DE93797509	
92-206	18:24158	OSTI; NTIS; INIS		DE93797557	
93-002	18:23597	OSTI; NTIS; INIS		DE93797568	
93-004	18:25272	OSTI; NTIS; INIS		DE93788461	
93-005	18:23641	OSTI; NTIS; INIS		DE93797569	
93-006	18:23369	OSTI; NTIS; INIS		DE93797596	
93-008	18:23428	OSTI; NTIS; INIS		DE93797597	
93-013	18:24034	OSTI; NTIS; INIS		DE93797598	
93-014	18:22886	OSTI; NTIS; INIS		DE93797584	
93-015	18:23642	OSTI; NTIS; INIS		DE93797570	
93-019	18:22887	OSTI; NTIS; INIS		DE93797599	
93-023	18:22865	OSTI; NTIS; INIS		DE93797600	
93-025	18:24892	OSTI; NTIS; INIS		DE93797611	
93-031	18:24159	OSTI; NTIS; INIS		DE93797609	
93-033	18:25404	OSTI; NTIS; INIS		DE93797613	
93-034	18:24749	OSTI; NTIS; INIS		DE93797601	
93-039	18:23643	OSTI; NTIS; INIS		DE93797602	
93-040	18:23484	OSTI; NTIS; INIS		DE93797603	
93-041	18:23529	OSTI; NTIS; INIS		DE93797604	
93-052	18:24121	OSTI; NTIS; INIS		DE93797608	
93-053	18:23150	OSTI; NTIS; INIS		DE93797605	
93-054	18:23151	OSTI; NTIS; INIS		DE93797606	
93-055	18:23152	OSTI; NTIS; INIS		DE93797607	
93-056	18:24108	OSTI; NTIS; INIS		DE93797610	
93-077	18:22982	OSTI; NTIS; INIS		DE93797612	
JINR–					
18-91-429	18:24119	OSTI; NTIS (US Sales Only); INIS		DE93625326	
9-90-165	18:24361	OSTI; NTIS (US Sales Only); INIS		DE93626170	
9-90-485	18:24322	OSTI; NTIS (US Sales Only); INIS		DE93626150	
JINR-D–					
2-91-499	18:24990	OSTI; NTIS (US Sales Only); INIS		DE93626637	
2-92-44	18:25016	OSTI; NTIS (US Sales Only); INIS		DE93626670	
7-91-481	18:25145	OSTI; NTIS (US Sales Only); INIS		DE93626906	
JINR-E–					
1-92-8	18:24362	OSTI; NTIS (US Sales Only); INIS		DE93626162	
1-92-101	18:24442	OSTI; NTIS (US Sales Only); INIS		DE93626356	
1-92-56	18:25146	OSTI; NTIS (US Sales Only); INIS		DE93626927	
1-92-68	18:25147	OSTI; NTIS (US Sales Only); INIS		DE93626886	
1-92-69	18:25148	OSTI; NTIS (US Sales Only); INIS		DE93626928	
11-91-560	18:25405	OSTI; NTIS (US Sales Only); INIS		DE93626603	

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11-92-236	18:24992	OSTI; NTIS (US Sales Only); INIS		DE93626638	
14-91-398	18:24080	OSTI; NTIS (US Sales Only); INIS		DE93625118	
2-92-103	18:25025	OSTI; NTIS (US Sales Only); INIS		DE93626692	
2-92-149	18:24967	OSTI; NTIS (US Sales Only); INIS		DE93626620	
2-92-264	18:25150	OSTI; NTIS (US Sales Only); INIS		DE93626887	
2-92-268	18:25026	OSTI; NTIS (US Sales Only); INIS		DE93626697	
2-92-269	18:25027	OSTI; NTIS (US Sales Only); INIS		DE93626690	
2-92-270	18:25017	OSTI; NTIS (US Sales Only); INIS		DE93626646	
2-92-322	18:24968	OSTI; NTIS (US Sales Only); INIS		DE93626621	
2-92-329	18:25028	OSTI; NTIS (US Sales Only); INIS		DE93626698	
2-92-39	18:24991	OSTI; NTIS (US Sales Only); INIS		DE93626639	
2-92-51	18:25040	OSTI; NTIS (US Sales Only); INIS		DE93626721	
2-92-64	18:25149	OSTI; NTIS (US Sales Only); INIS		DE93626888	
2-92-89	18:25041	OSTI; NTIS (US Sales Only); INIS		DE93626709	
4-92-113	18:25151	OSTI; NTIS (US Sales Only); INIS		DE93626895	
4-92-124	18:25069	OSTI; NTIS (US Sales Only); INIS		DE93626797	
4-92-282	18:25018	OSTI; NTIS (US Sales Only); INIS		DE93626671	
5-92-326	18:25019	OSTI; NTIS (US Sales Only); INIS		DE93626645	
5-92-75	18:24969	OSTI; NTIS (US Sales Only); INIS		DE93626622	
9-91-382	18:24323	OSTI; NTIS (US Sales Only); INIS		DE93626148	
9-91-383	18:24363	OSTI; NTIS (US Sales Only); INIS		DE93626155	
9-92-33	18:24364	OSTI; NTIS (US Sales Only); INIS		DE93626156	
JINR-R–					
10-91-302	18:24301	OSTI; NTIS (US Sales Only); INIS		DE93626132	
13-91-295	18:24368	OSTI; NTIS (US Sales Only); INIS		DE93626166	
13-91-317	18:24369	OSTI; NTIS (US Sales Only); INIS		DE93626157	
13-91-406	18:24370	OSTI; NTIS (US Sales Only); INIS		DE93626167	
13-91-424	18:24480	OSTI; NTIS (US Sales Only); INIS		DE93626409	
13-92-91	18:24443	OSTI; NTIS (US Sales Only); INIS		DE93626357	
15-92-50	18:24444	OSTI; NTIS (US Sales Only); INIS		DE93626386	
16-92-36	18:24302	OSTI; NTIS (US Sales Only); INIS		DE93626133	
2-92-35	18:25052	OSTI; NTIS (US Sales Only); INIS		DE93626781	
2-92-47	18:24970	OSTI; NTIS (US Sales Only); INIS		DE93626623	
2-92-48	18:24971	OSTI; NTIS (US Sales Only); INIS		DE93626624	
4-92-32	18:24972	OSTI; NTIS (US Sales Only); INIS		DE93626625	
5-91-559	18:25406	OSTI; NTIS (US Sales Only); INIS		DE93626604	
9-91-355	18:24365	OSTI; NTIS (US Sales Only); INIS		DE93626168	
9-92-129	18:24324	OSTI; NTIS (US Sales Only); INIS		DE93626149	
9-92-14	18:24366	OSTI; NTIS (US Sales Only); INIS		DE93626169	
9-92-37	18:24367	OSTI; NTIS (US Sales Only); INIS		DE93626158	
Jul–					
2636	18:23261	OSTI; NTIS (US Sales Only)		DE93791917	
2681	18:23940	OSTI; NTIS (US Sales Only)		DE93792709	
2691	18:24566	OSTI; NTIS (US Sales Only)		DE93792712	
K/CSD/INF–					
87/13-Rev.1	18:23153	OSTI; NTIS; GPO Dep.	E 1.99:	DE93009336	
K/CWM–					
18	18:22983	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93008859	MF-510
K/EM–					
24/R1	18:23092	*See* ORNL/M–2563			
24/R2	18:24826	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013731	MF-502
K/ER–					
56	18:22984	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93008690	MF-903
K/ITP–					
486	18:23154	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012415	MF-506
K/QT–					
389	18:22985	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93009333	MF-721
K/SUB–					
90-NH989/2	18:24752	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012196	MF-502
KAPL–					
4735	18:24109	OSTI; NTIS; GPO Dep.	E 1.99:	DE92016359	PC-901
KCP–					
613-4857	18:24750	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012378	PC-702
613-4940	18:23941	OSTI; NTIS; GPO Dep.	E 1.99:	DE93008843	PC-706
613-5037	18:24160	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013623	PC-706
613-5193	18:23836	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012885	MF-702
KFKI–					
1992-13/A	18:25042	OSTI; NTIS (US Sales Only); INIS		DE93626722	
1992-15/A	18:25078	OSTI; NTIS (US Sales Only); INIS		DE93626836	
1992-17/G	18:23429	OSTI; NTIS (US Sales Only); INIS		DE93626268	
1992-18/G	18:23485	OSTI; NTIS (US Sales Only); INIS		DE93626213	

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1992-19/G,I	18:23452	OSTI; NTIS (US Sales Only); INIS		DE93626294	
1992-20/K	18:24751	OSTI; NTIS (US Sales Only); INIS		DE93625616	
1992-22/B	18:24993	OSTI; NTIS (US Sales Only); INIS		DE93626640	
1992-23/G	18:25084	OSTI; NTIS (US Sales Only); INIS		DE93626846	
1992-25/G	18:25407	OSTI; NTIS (US Sales Only); INIS		DE93626605	
KTM/E-B–					
122	18:22649	OSTI; NTIS		DE93794855	
127	18:22770	OSTI; NTIS		DE93794853	
KURRI-TR–					
373	18:24893	OSTI; NTIS; INIS		DE93797621	
KY/ER–					
15	18:23134	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012077	MF-902
LA–					
12346-MS	18:24930	OSTI; NTIS; GPO Dep.	E 1.99:	DE93009117	MF-408
12413	18:24445	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014019	MF-712; MF-706
12416-MS	18:24753	OSTI; NTIS; GPO Dep.	E 1.99:	DE93011038	
12417-MS	18:24754	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93011990	
12418-MS	18:24755	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93011992	
12419-MS	18:24756	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93011991	
12436-MS-Vol.1	18:24081	OSTI; NTIS; GPO Dep.	E 1.99:	DE93011791	MF-902; MF-907
12436-MS-Vol.2	18:24082	OSTI; NTIS; GPO Dep.	E 1.99:	DE93011792	MF-902; MF-907
12446-MS	18:22986	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93008854	MF-721
12450-MS	18:24559	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013594	PC-700; PC-900
12455-MS	18:24518	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93014111	MF-741
12481	18:23644	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93011569	
12482-MS	18:23782	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014025	MF-706
12489-MS	18:24560	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013596	PC-700; PC-900
12498-PR	18:24757	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93008078	MF-721; MF-702
12503-MS	18:24135	OSTI; NTIS; GPO Dep.	E 1.99:	DE93011986	MF-361
12520	18:23976	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014017	MF-700
12528	18:22987	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013595	PC-721
12534-C	18:24955	OSTI; NTIS; GPO Dep.	E 1.99:	DE93009161	MF-703
12546-MS	18:23893	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013599	MF-700
12570	18:25162	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014012	MF-905; MF-705
93009869	18:25196	OSTI; NTIS; GPO Dep.	E 1.99:	DE93009869	MF-700
LA-SUB–					
92-12-Vol.1	18:22988	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93008404	MF-721
92-12-Vol.2	18:22989	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93008405	MF-721
93-100	18:24446	OSTI; NTIS; GPO Dep.	E 1.99:	DE93009411	MF-706
93-121	18:22821	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012074	MF-122
93-123	18:25197	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93012881	
93-128	18:23218	OSTI; NTIS; GPO Dep.	E 1.99:	DE93010816	
93-150	18:24519	OSTI; NTIS; GPO Dep.	E 1.99:	DE93011247	MF-741
93-168	18:24278	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012921	MF-704; MF-700
93-169	18:24760	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012081	MF-908
93-171	18:24083	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012915	MF-701
93-173	18:24490	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012895	
93-177	18:23297	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012919	
93-184	18:24520	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013916	
93-38	18:24758	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93008000	MF-902
93-46/1	18:23749	OSTI; NTIS; GPO Dep.	E 1.99:	DE93008402	MF-900
93-46/2	18:23750	OSTI; NTIS; GPO Dep.	E 1.99:	DE93008403	MF-900
93-48	18:24827	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93008674	MF-902
93-51	18:22990	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93008917	MF-814
93-63	18:24371	OSTI; NTIS; GPO Dep.	E 1.99:	DE93008819	MF-910
93-74	18:24894	OSTI; INIS; NTIS (documentation only); ESTSC (complete software package), P.O. Box 1020, Oak Ridge, TN 37831-1020; GPO Dep.	E 1.99:	DE93008468	MF-702
93-76	18:24759	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93008911	
93-92	18:22991	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93008679	MF-902; MF-940
LA-UR–					
92-3503	18:23645	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012447	MF-731

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
92-3770	18:25408	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003832	MF-905; MF-906
93-1025	18:24162	OSTI; NTIS; GPO Dep.	E 1.99:	DE93010733	MF-906
93-1069	18:24957	OSTI; NTIS; GPO Dep.	E 1.99:	DE93010739	MF-903
93-1119	18:24521	OSTI; NTIS; GPO Dep.	E 1.99:	DE93010742	MF-741
93-1162	18:24447	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012630	MF-904; MF-906
93-1180	18:24522	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012627	MF-741
93-1197	18:22996	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012624	MF-940
93-1200	18:24762	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012622	MF-705
93-1204	18:22997	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012661	MF-940
93-1241	18:24994	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012656	MF-700
93-1243	18:25053	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012655	MF-910
93-1286	18:24995	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012648	
93-1296	18:25202	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012645	MF-405
93-1338	18:25163	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012639	MF-705
93-1366	18:23135	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012664	MF-940
93-1382	18:25273	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012682	MF-700
93-1388	18:25043	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012679	MF-414
93-1389	18:24448	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012678	MF-906; MF-910
93-1392	18:25164	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012677	MF-910; MF-905
93-1393	18:25274	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012676	MF-700
93-1408	18:25177	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012674	MF-700
93-1414	18:25230	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012673	MF-906
93-1420	18:24982	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012672	MF-410
93-1444	18:24163	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93012668	
93-1470	18:24996	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012751	MF-412
93-1471	18:25044	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012750	MF-410
93-1502	18:25045	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012747	MF-413
93-1503	18:25152	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012746	MF-413
93-1511	18:25020	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012743	MF-413
93-1517	18:24372	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012742	
93-1519	18:25215	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012740	MF-404; MF-410
93-1532	18:25046	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012737	MF-700
93-1557	18:24523	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012733	MF-741
93-1605	18:24997	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012720	MF-910
93-1608	18:24998	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012717	MF-910
93-1609	18:24999	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012716	MF-910
93-1618	18:24035	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012713	MF-332
93-1625	18:25153	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012712	MF-413
93-1647	18:24852	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012708	MF-908
93-1659	18:25409	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012706	MF-706
93-1670	18:23942	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014425	MF-700
93-1689	18:23791	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014450	MF-332
93-1866	18:24430	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014479	MF-414
93-1872	18:24303	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014476	
93-1873	18:24373	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014474	
93-1903	18:24374	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014463	MF-910
93-1947	18:24375	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014357	MF-700
93-1961	18:24325	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014354	MF-405; MF-414
93-197	18:24161	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93007382	
93-2040	18:24376	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014390	MF-414
93-268	18:23646	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93007373	MF-940
93-269	18:23647	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93007372	MF-940
93-456	18:22992	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93008714	MF-940
93-484	18:24761	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93008705	
93-507	18:24828	OSTI; NTIS; GPO Dep.	E 1.99:	DE93008704	MF-910
93-656	18:22993	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93008728	MF-940
93-697	18:22994	OSTI; NTIS; GPO Dep.	E 1.99:	DE93008724	MF-732
93-735	18:23302	OSTI; NTIS; GPO Dep.	E 1.99:	DE93008719	MF-251; MF-257
93-747	18:24895	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93010729	MF-414; MF-407
93-856	18:24956	OSTI; NTIS; GPO Dep.	E 1.99:	DE93010713	MF-403
93-857	18:24595	OSTI; NTIS; GPO Dep.	E 1.99:	DE93010712	MF-402
93-910	18:23303	OSTI; NTIS; GPO Dep.	E 1.99:	DE93010707	MF-250
93-998	18:22995	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93010726	MF-940

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LALP–					
93-17	18:25315	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93010271	PC-700
LBF-FB–					
196(1992)	18:23943	OSTI; NTIS (US Sales Only)		DE93792325	
LBL–					
30933	18:23350	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93010442	
32480	18:24377	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93010462	MF-414
32529	18:24250	OSTI; NTIS; GPO Dep.	E 1.99:	DE93010408	MF-903
32874	18:22998	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93010444	MF-814
33230	18:23736	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015373	
33232	18:25029	OSTI; NTIS; INIS; OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93010451	MF-414
33295	18:24449	OSTI; NTIS; GPO Dep.	E 1.99:	DE93010406	MF-407
33404	18:23813	OSTI; NTIS; GPO Dep.	E 1.99:	DE93010458	MF-350
33447	18:22999	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013908	MF-810; MF-250
33464	18:23000	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93010421	MF-814
33614	18:23001	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93010411	MF-400
33660	18:23002	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93010413	MF-800
33661	18:23003	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93010431	MF-814
33663	18:23004	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93010414	MF-800
33753	18:24084	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013915	MF-404
33903	18:25070	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013913	MF-413
33932	18:23262	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013737	MF-408
33959	18:25079	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013819	MF-413
33982	18:24471	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013909	MF-414
33995	18:25000	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013903	MF-405
34031	18:24110	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015036	MF-404
34036	18:24326	*See* SLAC-PUB–6163			
LBL-PUB–					
3115	18:23737	OSTI; NTIS; GPO Dep.	E 1.99:	DE93010436	MF-402
LIYaF–					
1563	18:23598	OSTI; NTIS (US Sales Only); INIS		DE93626300	
1597	18:23530	OSTI; NTIS (US Sales Only); INIS		DE93626241	
1612	18:23486	OSTI; NTIS (US Sales Only); INIS		DE93626214	
LLNL-M–					
276-Rev.2	18:25410	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012502	MF-705
LMF–					
136	18:23545	*See* NUREG/CR–4214-Rev.1-Pt.2-Add.2			
138	18:24896	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013024	PC-408
LRP–					
471/93	18:25275	OSTI; NTIS; INIS		DE93627089	
LTKK-EN-A–					
16	18:23285	OSTI; NTIS		DE93794786	
MAFF-AEMR–					
32	18:24829	OSTI; NTIS (US Sales Only); INIS		DE93625636	
MLM–					
3517	18:24763	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93011021	MF-702
3767	18:24164	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013053	PC-704
3780	18:24141	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93013079	PC-700
NAL-TM–					
647	18:23822	OSTI; NTIS; Available from National Aerospace Laboratory, 44-1, Shindaiji Higashicho 7-chome, Chofu-City, Tokyo, Japan		DE93793614	
648T	18:24251	OSTI; NTIS; Available from National Aerospace Laboratory, 44-1, Shindaiji Higashicho 7-chome, Chofu-City, Tokyo, Japan		DE93793615	
NAL-TR–					
1145	18:23823	OSTI; NTIS; Available from National Aerospace Laboratory, 44-1, Shindaiji Higashicho 7-chome, Chofu-City, Tokyo, Japan		DE93793616	
1149	18:23862	OSTI; NTIS; Available from National Aerospace Laboratory, 44-1, Shindaiji Higashicho 7-chome, Chofu-City, Tokyo, Japan		DE93793617	
1154	18:25411	OSTI; NTIS; Available from National Aerospace Laboratory, 44-1, Shindaiji Higashicho 7-chome, Chofu-City, Tokyo, Japan		DE93793618	
1155	18:23863	OSTI; NTIS; Available from National Aerospace Laboratory, 44-1, Shindaiji Higashicho 7-chome, Chofu-City, Tokyo, Japan		DE93793619	
1156	18:24252	OSTI; NTIS; Available from National Aerospace Laboratory, 44-1, Shindaiji Higashicho 7-chome, Chofu-City, Tokyo, Japan		DE93793620	

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1157	18:24253	OSTI; NTIS; Available from National Aerospace Laboratory, 44-1, Shindaiji Higashicho 7-chome, Chofu-City, Tokyo, Japan		DE93793621	
1159	18:24036	OSTI; NTIS; Available from National Aerospace Laboratory, 44-1, Shindaiji Higashicho 7-chome, Chofu-City, Tokyo, Japan		DE93793622	
1160	18:24037	OSTI; NTIS; Available from National Aerospace Laboratory, 44-1, Shindaiji Higashicho 7-chome, Chofu-City, Tokyo, Japan		DE93793623	
1165	18:23824	OSTI; NTIS; Available from National Aerospace Laboratory, 44-1, Shindaiji Higashicho 7-chome, Chofu-City, Tokyo, Japan		DE93793624	
1172	18:24254	OSTI; NTIS; Available from National Aerospace Laboratory, 44-1, Shindaiji Higashicho 7-chome, Chofu-City, Tokyo, Japan		DE93793625	
1174T	18:23864	OSTI; NTIS; Available from National Aerospace Laboratory, 44-1, Shindaiji Higashicho 7-chome, Chofu-City, Tokyo, Japan		DE93793626	
NEA-CRP-L–					
331	18:24165	OSTI; NTIS (US Sales Only); INIS		DE93626125	
338	18:22895	OSTI; NTIS (US Sales Only); INIS		DE93626122	
339	18:22896	OSTI; NTIS (US Sales Only); INIS		DE93626123	
NEDO–					
P-9103	18:23774	OSTI; NTIS; Available from New Energy and Industrial Technology Development Organization, Sunshine 60, 30F 1-1, 3-chome, Higashi-Ikebukuro, Toshima-ku, Tokyo, Japan		DE93794618	
NEDO-P–					
9101	18:23772	OSTI; NTIS; Available from New Energy and Industrial Technology Development Organization, Sunshine 60, 30F 1-1, 3-chome, Higashi-Ikebukuro, Toshima-ku, Tokyo, Japan		DE93794616	
9102	18:23773	OSTI; NTIS; Available from New Energy and Industrial Technology Development Organization, Sunshine 60, 30F 1-1, 3-chome, Higashi-Ikebukuro, Toshima-ku, Tokyo, Japan		DE93794617	
9104	18:23775	OSTI; NTIS; Available from New Energy and Industrial Technology Development Organization, Sunshine 60, 30F 1-1, 3-chome, Higashi-Ikebukuro, Toshima-ku, Tokyo, Japan		DE93794619	
9105	18:23776	OSTI; NTIS; Available from New Energy and Industrial Technology Development Organization, Sunshine 60, 30F 1-1, 3-chome, Higashi-Ikebukuro, Toshima-ku, Tokyo, Japan		DE93794620	
9109	18:23738	OSTI; NTIS; Available from New Energy and Industrial Technology Development Organization, Sunshine 60, 30F 1-1, 3-chome, Higashi-Ikebukuro, Toshima-ku, Tokyo, Japan		DE93794621	
9119	18:23331	OSTI; NTIS; Available from New Energy and Industrial Technology Development Organization, Sunshine 60, 30F 1-1, 3-chome, Higashi-Ikebukuro, Toshima-ku, Tokyo, Japan		DE93794622	
9126	18:23739	OSTI; NTIS; Available from New Energy and Industrial Technology Development Organization, Sunshine 60, 30F 1-1, 3-chome, Higashi-Ikebukuro, Toshima-ku, Tokyo, Japan		DE93794623	
NEI-DK–					
1102	18:24596	OSTI; NTIS; INIS		DE93625642	
1130	18:23814	OSTI; NTIS		DE93794678	
1131	18:22785	OSTI; NTIS		DE93794680	
1132	18:22786	OSTI; NTIS		DE93794681	
1133	18:22787	OSTI; NTIS		DE93794682	
1137	18:22788	OSTI; NTIS		DE93794679	
1141	18:23815	OSTI; NTIS		DE93794676	
1142	18:23209	OSTI; NTIS		DE93794677	
1143	18:24625	OSTI; NTIS		DE93794683	
1143	18:25379	OSTI; NTIS; INIS		DE93624759	
1145	18:23770	OSTI; NTIS		DE93794687	
1146	18:23771	OSTI; NTIS; INIS		DE93794688	
1147	18:23225	OSTI; NTIS; INIS		DE93794684	
1148	18:23226	OSTI; NTIS; INIS		DE93794685	

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
1149	18:23198	OSTI; NTIS; INIS		DE93794674	
1150	18:23837	OSTI; NTIS		DE93794692	
1151	18:23825	OSTI; NTIS		DE93794691	
1152	18:23286	OSTI; NTIS		DE93794690	
1153	18:23721	OSTI; NTIS; INIS		DE93794689	
1155	18:23838	OSTI; NTIS		DE93794748	
1156	18:23849	OSTI; NTIS		DE93794746	
1158	18:23792	OSTI; NTIS		DE93794737	
1159	18:23311	OSTI; NTIS		DE93794749	
1160	18:23722	OSTI; NTIS		DE93794757	
1161	18:23850	OSTI; NTIS		DE93794747	
1164	18:22789	OSTI; NTIS		DE93794729	
1165	18:24626	OSTI; NTIS		DE93794731	
1168	18:23193	OSTI; NTIS		DE93794694	
1169	18:23826	OSTI; NTIS		DE93794745	
1170	18:23827	OSTI; NTIS		DE93794758	
1171	18:23207	OSTI; NTIS; INIS		DE93794756	
1176	18:24627	OSTI; NTIS		DE93794750	
1177	18:23696	OSTI; NTIS		DE93794743	
1179	18:24628	OSTI; NTIS		DE93794744	
1180	18:23205	OSTI; NTIS		DE93794761	
NEI-FI–					
201	18:23769	OSTI; NTIS		DE93794777	
202	18:24629	OSTI; NTIS		DE93794807	
203	18:23332	OSTI; NTIS		DE93794809	
207	18:23752	OSTI; NTIS		DE93794797	
NEI-NO–					
329	18:24038	OSTI; NTIS; INIS		DE93625581	
330	18:24897	OSTI; NTIS; INIS		DE93625751	
332	18:23005	OSTI; NTIS; INIS		DE93626427	
338	18:22843	OSTI; NTIS; INIS		DE93794943	
339	18:22844	OSTI; NTIS; INIS		DE93794945	
NESC–					
1028	18:25399	*See* ESTSC–000583I037000			
275	18:25397	*See* ESTSC–000337C017500			
NEA0672	18:25400	*See* ESTSC–000584IBMPC00			
NIIAR–					
13-796	18:23462	OSTI; NTIS (US Sales Only); INIS		DE93626297	
14-797	18:23513	OSTI; NTIS (US Sales Only); INIS		DE93626233	
16-799	18:23514	OSTI; NTIS (US Sales Only); INIS		DE93626410	
17-800	18:24166	OSTI; NTIS (US Sales Only); INIS		DE93626129	
NIIEFA-P-V–					
0852	18:24378	OSTI; NTIS (US Sales Only); INIS		DE93626177	
NIPER–					
578	18:22822	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93000141	PC-122
663	18:22823	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000135	PC-122
686	18:22824	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014219	MF-122; MF-125
NPRW-SA–					
91-7	18:23453	*See* SAND–91-2383			
NREL/TP–					
410-5335	18:23263	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000092	MF-270
411-5450	18:23271	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000099	MF-270
411-5453	18:23264	OSTI; NTIS; GPO Dep.	E 1.99:	DE93010006	MF-271
411-5454	18:23265	OSTI; NTIS; GPO Dep.	E 1.99:	DE93010007	MF-271
411-5456	18:23266	OSTI; NTIS; GPO Dep.	E 1.99:	DE93010009	MF-271
411-5457	18:23267	OSTI; NTIS; GPO Dep.	E 1.99:	DE93010021	MF-271
421-5150	18:23216	OSTI; NTIS; GPO Dep.	E 1.99:	DE93010025	MF-245
422-5259	18:23885	OSTI; NTIS; GPO Dep.	E 1.99:	DE93010024	MF-244
430-5399	18:24630	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000100	MF-249
432-4882	18:23828	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000033	MF-335
432-5068	18:23287	OSTI; NTIS; GPO Dep.	E 1.99:	DE93010010	MF-231
461-4857	18:23765	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000069	MF-233
471-5099	18:23288	OSTI; NTIS; GPO Dep.	E 1.99:	DE93010004	MF-231
NUREG–					
0020-Vol.17	18:23361	OSTI; NTIS; INIS; GPO		TI93011022	
0090-Vol.15-No.4	18:23648	OSTI; NTIS; INIS; GPO		TI93013230	
0325-Rev.16	18:23761	OSTI; NTIS; INIS; GPO		TI93010751	
0540-Vol.15-No.1	18:23473	OSTI; NTIS; INIS; GPO		TI93010497	
0540-Vol.15-No.2	18:23474	OSTI; NTIS; INIS; GPO		TI93012322	
0540-Vol.15-No.3	18:23475	OSTI; NTIS; INIS; GPO		TI93013829	

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0750-Vol.36-Index1	18:23476	OSTI; NTIS; INIS; GPO		TI93013283	
0750-Vol.36-No.6	18:23477	OSTI; NTIS; INIS; GPO		TI93010752	
0797-Suppl.27	18:23649	OSTI; NTIS; INIS; GPO		TI93012297	
0936-Vol.12-No.1	18:23478	OSTI; NTIS; INIS; GPO		TI93013289	
0940-Vol.11-No.4	18:23479	OSTI; NTIS; INIS; GPO		TI93010159	
1125-Vol.14	18:23650	OSTI; NTIS; INIS; GPO		TI93010646	
1474	18:23430	OSTI; NTIS; INIS; GPO		TI93013825	
1485	18:23651	OSTI; NTIS; INIS; GPO		TI93011827	
NUREG/CP–					
0126-Vol.1	18:23652	OSTI; NTIS; INIS; GPO		TI93011571	
0126-Vol.2	18:23653	OSTI; NTIS; INIS; GPO		TI93011967	
0126-Vol.3	18:23654	OSTI; NTIS; INIS; GPO		TI93011572	
NUREG/CR–					
4214-Rev.1-Pt.2-Add.2	18:23545	OSTI; NTIS; INIS; GPO		TI93013439	
4273	18:23655	OSTI; NTIS; INIS; GPO		TI93010943	
4551-Vol.7-Rev.1-Pt.1	18:23656	OSTI; NTIS; INIS; GPO		TI93010932	
4551-Vol.7-Rev.1-Pt.2A	18:23657	OSTI; NTIS; INIS; GPO		TI93010933	
4551-Vol.7-Rev.1-Pt.2B	18:23658	OSTI; NTIS; INIS; GPO		TI93010931	
4832-Vol.9	18:23659	OSTI; NTIS; INIS; GPO		TI93011568	
5672-Vol.3	18:23370	OSTI; NTIS; INIS; GPO		TI93008146	
5801	18:23660	OSTI; NTIS; INIS; GPO		TI93012886	
5917-Vol.1	18:23006	OSTI; NTIS; INIS; GPO		TI93008169	
5937	18:23661	OSTI; NTIS; INIS; GPO		TI93012825	
5957	18:23503	OSTI; NTIS; INIS; GPO		TI93013807	
5962	18:23184	OSTI; NTIS; INIS; GPO		TI93008013	
5972	18:23504	OSTI; NTIS; INIS; GPO		TI93011942	
5976	18:23662	OSTI; NTIS; INIS; GPO		TI93013191	
5984	18:23447	OSTI; NTIS; INIS; GPO		TI93013476	
5999	18:23371	OSTI; NTIS; INIS; GPO		TI93012532	
6011	18:23663	OSTI; NTIS; INIS; GPO		TI93010123	
6018	18:23531	OSTI; NTIS; INIS; GPO		TI93012609	
6027	18:23664	OSTI; NTIS; INIS; GPO		TI93012637	
6035	18:25412	OSTI; INIS; GPO; NTIS (documentation only); ESTSC (complete software package), P.O. Box 1020, Oak Ridge, TN 37831-1020		TI93013126	
NUREG/IA–					
0094	18:23487	OSTI; NTIS; INIS; GPO		TI93014618	
NVO–					
325-Rev.1	18:23008	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93008616	MF-940; MF-902
325LRD-Rev.1	18:23007	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93008855	MF-940; MF-902
NWPO-SE–					
045-92	18:23009	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013217	MF-814
054-92	18:23010	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013216	MF-814
NWPO-TR–					
017-91	18:23011	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013214	MF-814
018-91	18:23012	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013215	MF-814
NYSERDA–					
93-2	18:23851	OSTI; New York State Energy Research and Development Authority, Two Rockefeller Plaza, Albany, NY 12223		TI93012419	
OCDO–					
93012029	18:23343	OSTI; Ohio Coal Development Office, 77 S. High Street, P.O. Box 1001, Columbus, OH 43266-0001 (United States)		TI93012029	
93012030	18:23344	OSTI; Ohio Coal Development Office, 77 S. High Street, P.O. Box 1001, Columbus, OH 43266-0001 (United States)		TI93012030	
93012032	18:23333	OSTI; Ohio Coal Development Office, 77 S. High Street, P.O. Box 1001, Columbus, OH 43266-0001 (United States)		TI93012032	
93013790	18:23345	OSTI; Ohio Coal Development Office, 77 S. High Street, P.O. Box 1001, Columbus, OH 43266-0001		TI93013790	
93013795	18:22750	OSTI; Ohio Coal Development Office, 77 S. High Street, Box 1001, Columbus, OH 43266-0001		TI93013795	
93013796	18:22658	OSTI; Ohio Coal Development Office, 77 High Street, P.O. Box 1001, Columbus, OH 43266-0001 (United States)		TI93013796	

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
OCDO–					
93013797	18:23346	OSTI; Ohio Coal Development Office, 77 S. High Street, P.O. Box 1001, Columbus, OH 43266-0001		TI93013797	
93013798	18:23347	OSTI; Ohio Coal Development Office, 77 S. High Street, P.O. Box 1001, Columbus, OH 43266-0001		TI93013798	
93013799	18:23348	OSTI; Ohio Coal Development Office, 77 S. High Street, P.O. Box 1001, Columbus, OH 43266–0001		TI93013799	
ORAU–					
88/C-71	18:25474	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013315	MF-700
91/G-52	18:25380	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013317	MF-700
ORNL–					
6623	18:23091	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93008239	MF-511
6733	18:24567	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013865	MF-402
6743	18:23829	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013846	MF-330
ORNL/CDIAC–					
54	18:24830	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93007799	MF-902
ORNL/CON–					
333	18:23816	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012517	MF-350
356	18:23852	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012427	MF-350
ORNL/CSD/FTR–					
4423	18:22897	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93012112	MF-714; MF-722
ORNL/ER–					
138	18:24764	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93010256	MF-902
ORNL/FMP–					
93/3	18:23911	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013097	MF-114
ORNL/FTR–					
4165	18:23912	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93011056	MF-404
4176	18:23944	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93011090	MF-404
4183	18:24450	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93011089	MF-414
4184	18:25013	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93011087	MF-414
4194	18:24765	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93011104	MF-901; MF-903
4200	18:23599	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93011029	MF-420
4205	18:24085	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93010574	MF-406
4208	18:24766	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93011105	MF-902
4214	18:23945	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93011107	MF-404; MF-406
4215	18:24481	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93011108	MF-332
4219	18:25071	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93010573	MF-413
4221	18:24631	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93011242	MF-402
4228	18:23448	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93011289	MF-522
4230	18:24931	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93011291	MF-402
4233	18:23723	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93011112	MF-350
4236	18:25085	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93011111	MF-413
4243	18:23946	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93011094	MF-404
4245	18:25475	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93011079	MF-400
4257	18:24898	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93011080	MF-402
4258	18:24767	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93011081	MF-402
4259	18:23532	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93011078	MF-400
4276	18:24304	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93011064	MF-414
4277	18:24451	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93011073	MF-406
4283	18:23947	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93011072	MF-114
4284	18:24379	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93011066	MF-413
4297	18:24111	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93011077	MF-401
4300	18:24932	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93011076	MF-407
4301	18:23860	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93011058	MF-332
4302	18:23600	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93011070	MF-1030
4324	18:23179	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93012406	MF-413
4331	18:24039	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93012688	MF-520
4336	18:25047	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93012242	MF-413
4366	18:25216	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93012408	MF-413
4371	18:25413	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93012243	MF-405
4388	18:24040	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93012111	MF-404
4390	18:23533	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93011741	MF-520
4397	18:24768	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93012120	MF-402
4398	18:23505	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93009222	
4402	18:25414	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93012114	MF-405

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
4403	18:23853	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93011092	
4429	18:22898	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93009924	MF-610
4432	18:23665	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93009221	
4433	18:23666	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93009930	MF-523
4441	18:24769	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93009929	MF-402
4446	18:23351	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93009779	MF-402
4456	18:23449	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93009934	MF-520
4473	18:23013	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93009778	MF-407
4545	18:24943	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93011821	MF-402
4562	18:24770	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93011817	MF-902
4564	18:24869	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93011814	MF-400
4568	18:23977	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93011585	MF-406
4569	18:22899	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93011561	MF-610
4572	18:25168	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93012553	MF-414
ORNL/M–					
1759	18:24771	OSTI; NTIS; GPO Dep.	E 1.99:	DE93008984	MF-402
1760	18:24831	OSTI; NTIS; GPO Dep.	E 1.99:	DE93009792	MF-402
2542	18:23134	*See* KY/ER–15			
2563	18:23092	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93008487	MF-902
2648	18:23741	OSTI; NTIS; GPO Dep.	E 1.99:	DE93009791	MF-630
2711	18:23180	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014661	MF-404
2722	18:25301	*See* DOE/ER–0313/13			
2788	18:23913	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014013	MF-114
ORNL/RASA–					
92/14	18:24772	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93010257	MF-902
ORNL/Sub–					
91-SG105/1	18:24552	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012094	MF-222
ORNL/TM–					
11212	18:24632	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013452	
11916	18:24899	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013453	MF-607
12090	18:22900	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013471	MF-940
12094	18:23948	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012865	MF-424
12124	18:22901	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013472	MF-900
12148	18:24900	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93012507	
12170	18:25222	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012872	MF-404
12209	18:25276	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013463	PC-427
12226	18:24773	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013455	MF-403
12231	18:25415	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013456	MF-405
12264	18:25316	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012515	MF-427
12274	18:24524	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93012996	
12280	18:23504	*See* NUREG/CR–5972			
12287	18:25416	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012539	MF-405
12297	18:23014	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013459	MF-902
12330	18:24491	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93012511	MF-500
12337	18:24167	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012093	MF-906
12358	18:25080	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013474	MF-413
12375	18:25417	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013470	MF-406
2648/R1	18:23742	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013469	MF-630
PATENTS-US–					
A7678387	18:24168	OSTI; NTIS; GPO Dep.	E 1.99:	DE93008230	MF-706
A7681291	18:23136	OSTI; NTIS; GPO Dep.	E 1.99:	DE93008217	MF-707
A7686442	18:24269	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012018	MF-706
A7689425	18:23667	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012016	MF-706
A7693466	18:24086	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012012	MF-706
A7693477	18:24169	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012011	MF-906
A7697158	18:24944	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012003	MF-706
A7700286	18:24279	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012002	MF-700
A7703641	18:22888	OSTI; NTIS; GPO Dep.	E 1.99:	DE93011998	MF-400
A7704590	18:24280	OSTI; NTIS; GPO Dep.	E 1.99:	DE93011997	MF-706
A7705408	18:24482	OSTI; NTIS; GPO Dep.	E 1.99:	DE93011996	MF-706
A7707414	18:23894	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93011994	MF-506
PCMDI–					
7	18:24645	*See* UCRL-ID–111532-Rev.1			
8	18:24947	*See* UCRL-ID–112719			
9	18:24643	*See* UCRL-ID–108158			
11	18:24646	*See* UCRL-ID–113623			
PEP–					
92-150	18:24148	*See* DOE/FTR–93011550			
PNL–					
3777-Rev.2	18:24901	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012832	MF-907
3826	18:24633	OSTI; NTIS; GPO Dep.	E 1.99:	DE93008062	MF-502

PNL–

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
8144	18:23137	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93008948	MF-902
8485	18:24774	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93009083	MF-703
8492	18:23015	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012861	MF-940
8502	18:23016	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93007931	MF-721
8506	18:24775	OSTI; NTIS; GPO Dep.	E 1.99:	DE93008628	MF-702
8531	18:23093	OSTI; NTIS; GPO Dep.	E 1.99:	DE93011019	MF-603
8532	18:24776	OSTI; NTIS; GPO Dep.	E 1.99:	DE93008626	MF-602
8539	18:24958	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012240	MF-903
8570	18:23138	OSTI; NTIS; GPO Dep.	E 1.99:	DE93010357	MF-600
8572	18:23139	OSTI; NTIS; GPO Dep.	E 1.99:	DE93010358	MF-600
8574	18:24945	OSTI; NTIS; GPO Dep.	E 1.99:	DE93010359	MF-600
8600	18:23839	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013109	MF-332
8616	18:23817	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014185	MF-350
8618	18:23017	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013110	MF-902
8629	18:25178	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013500	MF-713
8638	18:24170	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013125	
8650-Pt.1	18:24933	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013502	MF-408
8652	18:23140	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014184	MF-721
PNL-SA–					
20281	18:23018	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93007866	MF-510
20592	18:23019	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93008258	MF-630
20740	18:24777	OSTI; NTIS; GPO Dep.	E 1.99:	DE93007870	MF-902
20747	18:23141	OSTI; NTIS; GPO Dep.	E 1.99:	DE93009217	MF-502
20802	18:23020	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93008259	MF-902
20853	18:24778	OSTI; NTIS; GPO Dep.	E 1.99:	DE93008915	MF-902
20914	18:24634	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93007998	MF-502
20922	18:23142	OSTI; NTIS; GPO Dep.	E 1.99:	DE93007869	MF-902
20964	18:23143	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93008261	MF-902
20985	18:24779	OSTI; NTIS; GPO Dep.	E 1.99:	DE93008990	MF-511
21011	18:24902	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93007997	MF-507
21014	18:24903	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93007996	MF-507
21080	18:24832	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93007874	MF-502
21236	18:24041	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93011034	MF-401
21238	18:24042	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93011035	MF-404
21258	18:23021	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013162	MF-510
21377	18:24635	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93007887	MF-402
21393	18:23022	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93009340	MF-510
21394	18:23023	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93009339	
21453	18:23024	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93009479	MF-510
21459	18:23025	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93007886	MF-607
21463	18:23026	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93009475	MF-901
21476	18:23144	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93007885	MF-407
21478	18:24636	OSTI; NTIS; GPO Dep.	E 1.99:	DE93008991	MF-502
21486	18:24637	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93007884	MF-402
21491	18:23949	OSTI; NTIS; GPO Dep.	E 1.99:	DE93011602	MF-404
21492	18:24638	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93007883	MF-402
21537	18:24780	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93009477	MF-902
21559	18:23027	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013166	MF-940
21663	18:24112	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012869	MF-102
21664	18:22729	OSTI; NTIS; GPO Dep.	E 1.99:	DE93010794	MF-108
21665	18:22730	OSTI; NTIS; GPO Dep.	E 1.99:	DE93011603	MF-108
21710	18:24781	OSTI; NTIS; GPO Dep.	E 1.99:	DE93007993	MF-902
21727	18:22902	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93007879	MF-812
21731	18:23145	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93007877	MF-902
21772	18:23305	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013284	MF-402
21790	18:25418	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012867	MF-505
21812	18:24043	OSTI; NTIS; GPO Dep.	E 1.99:	DE93010805	MF-404
21833	18:23668	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93009476	MF-523; MF-511
21856	18:23028	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93010167	MF-902
21865	18:24782	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93009810	MF-510
21893	18:23029	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93009815	MF-510
21966	18:24639	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013186	MF-402
21968	18:24946	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013454	MF-507
21972	18:24904	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013158	MF-500
22016	18:23763	OSTI; NTIS; GPO Dep.	E 1.99:	DE93011601	MF-310
22020	18:23146	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013159	MF-607
22022	18:23753	OSTI; NTIS; GPO Dep.	E 1.99:	DE93009816	MF-310
22047	18:23030	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93009813	MF-900
22157	18:23818	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012866	MF-350
22216	18:23766	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013286	MF-900

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
22241	18:24905	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013285	MF-907
22251	18:24783	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013160	MF-903
22264	18:23031	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013165	MF-810
22394	18:24640	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013507	MF-902
PNWD–					
1980-10-HEDR	18:24906	OSTI; NTIS; INIS		DE93012321	
2020-HEDR	18:24907	OSTI; NTIS; INIS		DE93011651	
2033-HEDR-Vol.1	18:24908	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93011909	
2113-HEDR-Draft	18:24909	OSTI; NTIS; GPO Dep.	E 1.99:	DE93011017	
2129-HEDR	18:24910	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93012621	
POEF-T–					
3545	18:22867	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93008985	MF-501
3605	18:25381	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012084	MF-500
POEF/ER/Sub–					
88/4551/D1-Vol.1	18:23032	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93007778	MF-630
88/4551/D1-Vol.3	18:24784	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93007780	MF-630
88/4551/D1-Vol.4	18:24785	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93007781	MF-630
PPPL–					
2879	18:25317	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93011498	PC-420
2882	18:25277	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93011982	PC-420
2890	18:25278	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93011496	PC-420; PC-421
2891	18:25279	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93011494	PC-420; PC-426
2893	18:25280	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93011977	PC-426
2896	18:25281	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93011980	PC-420; PC-426
PRRC–					
93-12	18:22805	*See* DOE/MC/26031–11			
PSI–					
93-01	18:23372	OSTI; NTIS; INIS		DE93626248	
PTB-Dos–					
21	18:24452	OSTI; NTIS (US Sales Only); INIS		DE93796871	
PTE–					
1	18:23033	OSTI; NTIS (US Sales Only); INIS		DE93792711	
RAE–					
8915-1	18:22991	*See* LA-SUB–93-92			
8915/2-1	18:22988	*See* LA-SUB–92-12-Vol.1			
8915/3-2	18:22989	*See* LA-SUB–92-12-Vol.2			
RAL–					
92-076	18:25419	OSTI; NTIS (US Sales Only); INIS		DE93626606	
92-078	18:25030	OSTI; NTIS (US Sales Only); INIS		DE93626699	
RCM–					
01192	18:24122	OSTI; NTIS (US Sales Only); INIS		DE93795289	
RFP–					
4611	18:23034	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012702	MF-721
4693	18:24483	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012704	MF-706
RI–					
214	18:23534	OSTI; NTIS (US Sales Only); INIS		DE93626242	
Riso-R–					
659(EN)	18:25282	OSTI; NTIS; INIS		DE93627052	
683(EN)	18:23312	OSTI; NTIS; Also available from Risoe Library, P.O. Box 49, DK-4000 Roskilde, Denmark		DE93794693	
SAIC–					
91/6660	18:23531	*See* NUREG/CR–6018			
93011823	18:23889	OSTI; NTIS; GPO Dep.	E 1.99:	DE93011823	MF-700
SAND–					
90-1827	18:23669	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93010609	MF-1000
91-2016C	18:25420	OSTI; NTIS; GPO Dep.	E 1.99:	DE93009838	MF-405
91-2383	18:23453	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93013963	MF-1033
91-2733	18:23035	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93011475	MF-940
91-7087	18:23660	*See* NUREG/CR–5801			
92-0347	18:24171	OSTI; NTIS; GPO Dep.	E 1.99:	DE93015126	MF-700
92-0480	18:24255	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012396	MF-706
92-0537-Vol.9	18:23659	*See* NUREG/CR–4832-Vol.9			
92-0824C	18:24044	OSTI; NTIS; GPO Dep.	E 1.99:	DE93009843	MF-700
92-0825C	18:24045	OSTI; NTIS; GPO Dep.	E 1.99:	DE93009845	MF-700
92-1148	18:23036	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012394	MF-721
92-1168C	18:24136	OSTI; NTIS; GPO Dep.	E 1.99:	DE93009798	MF-700

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
92-1185	18:24959	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013601	MF-705; MF-703
92-1537C	18:23037	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93011595	MF-903
92-1711	18:22825	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013600	MF-122
92-1716C	18:25203	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93011679	MF-700
92-1724C	18:25421	OSTI; NTIS; GPO Dep.	E 1.99:	DE93009828	MF-705
92-1934C	18:23038	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93011599	
92-1977	18:23506	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93013710	MF-940
92-2021	18:23670	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93007933	MF-523
92-2074C	18:23507	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93009853	
92-2086C	18:24492	OSTI; NTIS; GPO Dep.	E 1.99:	DE93010685	MF-705
92-2221C	18:24983	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013752	MF-706
92-2236C	18:24172	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012858	MF-902
92-2270C	18:23819	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012349	MF-902
92-2285	18:23039	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013948	MF-721
92-2297C	18:24261	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012838	MF-706
92-2346C	18:23272	OSTI; NTIS; GPO Dep.	E 1.99:	DE93011581	MF-236
92-2405C	18:24173	OSTI; NTIS; GPO Dep.	E 1.99:	DE93011555	MF-700
92-2498C	18:24046	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012839	MF-704
92-2515C	18:24493	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93012857	MF-706
92-2538-Vol.2	18:23672	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93012080	MF-940; MF-1031
92-2538/1	18:23671	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93012102	MF-940; MF-1031
92-2545	18:22859	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013497	MF-126
92-2585C	18:25422	OSTI; NTIS; GPO Dep.	E 1.99:	DE93011675	MF-705
92-2623C	18:24484	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013761	MF-706; MF-702
92-2660C	18:23040	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012350	MF-904
92-2670C	18:23041	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93011580	MF-800
92-2679C	18:23042	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93009855	MF-940
92-2716C	18:24494	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93006764	
92-2781C	18:23155	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93013756	
92-2804C	18:24281	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012842	MF-700
92-2845C	18:24495	OSTI; NTIS; GPO Dep.	E 1.99:	DE93011593	MF-705
92-7072	18:23043	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012398	MF-721
92-7284	18:24282	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013498	MF-700
92-7286	18:24833	OSTI; NTIS; GPO Dep.	E 1.99:	DE93007427	MF-721
92-7306	18:23044	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012395	MF-721
92-8003	18:24485	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012837	MF-705
93-0023C	18:23268	OSTI; NTIS; GPO Dep.	E 1.99:	DE93011669	MF-248
93-0037C	18:24283	OSTI; NTIS; GPO Dep.	E 1.99:	DE93007581	MF-700
93-0044C	18:25423	OSTI; NTIS; GPO Dep.	E 1.99:	DE93011673	MF-705
93-0050C	18:25424	OSTI; NTIS; GPO Dep.	E 1.99:	DE93011553	MF-700
93-0106C	18:24137	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012848	MF-706
93-0200	18:25165	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013602	MF-705
93-0224	18:25425	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012397	MF-705
93-0306	18:24496	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012385	MF-706
93-0347	18:23840	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013955	MF-706
93-0368	18:24553	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012439	MF-703
93-0436C	18:24284	OSTI; NTIS; GPO Dep.	E 1.99:	DE93010689	MF-700
93-0469C	18:22903	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93011578	MF-902
93-0539C	18:24472	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013765	MF-706
93-0582C	18:23978	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012859	MF-404
93-0588C	18:24174	OSTI; NTIS; GPO Dep.	E 1.99:	DE93009850	MF-906
93-0592C	18:23673	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93009848	
93-0593C	18:23674	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93009849	
93-0609C	18:24047	OSTI; NTIS; GPO Dep.	E 1.99:	DE93009844	MF-700
93-0678C	18:24175	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93011557	MF-906
93-0689C	18:25426	OSTI; NTIS; GPO Dep.	E 1.99:	DE93009841	MF-405
93-0690C	18:25427	OSTI; NTIS; GPO Dep.	E 1.99:	DE93010691	MF-705
93-0738	18:24554	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93013496	PC-700
93-0742C	18:25428	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93011680	MF-700
93-0757C	18:24525	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93011671	MF-706
93-0767C	18:25429	OSTI; NTIS; GPO Dep.	E 1.99:	DE93011678	MF-705
93-0812C	18:25217	OSTI; NTIS; GPO Dep.	E 1.99:	DE93011685	MF-704
93-0813C	18:24087	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93011574	MF-701
93-0825C	18:24048	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93011576	MF-701
93-0826C	18:24049	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012855	MF-704

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
93-0858	18:24497	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93013961	MF-706
93-0864C	18:23181	OSTI; NTIS; GPO Dep.	E 1.99:	DE93011674	MF-404
93-0886	18:23841	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013495	PC-900
93-0901C	18:25166	OSTI; NTIS; GPO Dep.	E 1.99:	DE93011556	MF-706
93-0908C	18:25430	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93011677	MF-705
93-0931C	18:24176	OSTI; NTIS; GPO Dep.	E 1.99:	DE93011554	MF-706
93-0955	18:25431	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012346	MF-705
93-0956C	18:25432	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012347	MF-705
93-0991C	18:24498	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93012345	MF-700
93-1003	18:23754	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013080	PC-900
93-1006C	18:24285	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012856	MF-706
93-1020C	18:24050	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013754	MF-704
93-1027C	18:23886	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012862	MF-940
93-1091C	18:24526	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93013758	MF-706
93-1125C	18:23895	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013775	MF-706
93-1152C	18:23762	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013769	MF-700
93-2805C	18:25231	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012843	MF-706; MF-704
93-8558C	18:24641	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012836	MF-902; MF-906
SCPRI-RM–					
12-1992	18:24642	OSTI; NTIS (US Sales Only); INIS		DE93625786	
SLAC–					
409	18:25048	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013593	PC-414
415	18:24088	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013389	PC-401; PC-404
SLAC-PUB–					
5895	18:25433	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93010949	MF-414
6057	18:25001	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93010950	MF-414
6060	18:24380	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93010951	MF-414
6061	18:24381	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93010952	MF-414
6067	18:24382	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93010954	MF-414
6068	18:25049	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93010955	MF-414
6163	18:24326	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013107	MF-414
SLAC/SSRL–					
0009	18:24088	*See* SLAC–415			
SMC–					
0080.	18:24874	*See* CNIC–00625			
SR/H–					
373	18:23558	*See* DPW–53-1232			
374	18:23519	*See* DPW–53-1238			
402	18:23559	*See* DPW–53-1430			
406	18:23562	*See* DPW–3816			
433	18:23541	*See* DPW–4408			
445	18:23565	*See* DPW–4148			
449	18:23540	*See* DPW–3990			
453	18:23563	*See* DPW–3909			
458	18:23564	*See* DPW–3989			
459	18:22965	*See* DPW–4300			
460	18:23566	*See* DPW–4295			
461	18:25454	*See* DPW–4461			
462	18:23188	*See* DPW–4466			
464	18:23567	*See* DPW–4489			
465	18:22964	*See* DPW–3637			
473	18:23560	*See* DPW–3694			
480	18:23561	*See* DPW–3720			
494	18:23520	*See* DPW–4785			
503	18:23570	*See* DPW–4906			
504	18:23571	*See* DPW–4908			
505	18:23521	*See* DPW–4864			
506	18:23569	*See* DPW–4851			
507	18:23568	*See* DPW–4836			
512	18:23553	*See* DPW–53-3-1			
513	18:23554	*See* DPW–53-3-3			
514	18:23555	*See* DPW–53-3-4			
515	18:23556	*See* DPW–53-3-5			
516	18:23493	*See* DPW–53-3-6			
517	18:22874	*See* DPW–53-3-8			
518	18:22875	*See* DPW–53-3-10			
519	18:23557	*See* DPW–53-3-11			
520	18:22882	*See* DPW–3652			

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
522	18:24911	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93012362	MF-708
523	18:23601	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93012363	MF-700
526	18:22910	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93012420	MF-700
535	18:23129	*See* DPSP–55-454-5			
536	18:23602	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93013022	MF-700
537	18:23603	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93013023	MF-700
548	18:23604	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93013449	MF-700
SREL–					
39	18:24834	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013822	MF-702
SRT-EMT–					
93-1035	18:23085	*See* WSRC-TR–93-172			
SRT-MTS–					
92-1241	18:23617	*See* WSRC-TR–93-002			
SSCL–					
606	18:24327	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013942	PC-414
618	18:24328	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013945	PC-414
619	18:24383	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013943	PC-414
SSCL-Preprint–					
149-Rev.1	18:24329	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012307	MF-414
203	18:24384	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012306	MF-400
208	18:24385	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012305	MF-414
210	18:24386	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014073	MF-414
215	18:24387	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012304	MF-414; MF-400
216	18:24388	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012303	MF-414
219	18:24389	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93011039	MF-414
220	18:24330	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93011605	MF-414
226	18:24390	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012301	MF-414
228	18:24391	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014171	MF-414
235	18:24392	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012299	MF-414
237	18:24393	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014075	MF-414
241	18:25054	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012308	MF-414
244	18:24394	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014258	MF-414
245	18:24395	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014179	MF-414
258	18:24462	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014080	MF-414
260	18:24396	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014247	MF-414
262	18:24397	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014141	MF-414
263	18:24398	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014142	MF-414
264	18:24399	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014246	MF-414
273	18:24400	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014137	MF-414
277	18:24401	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014182	MF-414
279	18:24402	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014174	MF-414
280	18:24403	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014133	MF-414
282	18:24404	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014173	MF-414
296	18:24405	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014010	MF-414
299	18:24331	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014256	MF-414
304	18:24332	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014259	MF-414
305	18:24406	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014077	MF-414
309	18:24407	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014177	MF-400; MF-414
311	18:24408	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014068	MF-414
318	18:24409	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014135	MF-414
320	18:24410	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014011	MF-414
323	18:24305	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014084	MF-414
326	18:24411	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014269	MF-414
327	18:24412	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014103	MF-414
333	18:24413	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014260	MF-414
342	18:24414	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014070	MF-414
349	18:24415	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014139	MF-414
351	18:24333	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014270	MF-414
355	18:24334	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014136	MF-414
356	18:24416	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014273	MF-414
358	18:24417	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014066	MF-414
361	18:24418	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014082	MF-414
363	18:24419	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014274	MF-414
365	18:24335	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014265	MF-414
366	18:24420	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014257	MF-414
371	18:24421	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014105	MF-414
373	18:24422	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014072	MF-414
375	18:24306	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014180	MF-414
376	18:24423	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014071	MF-414

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
378	18:24424	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014107	MF-414
382	18:24336	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014106	MF-414
386	18:24337	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014099	MF-414
389	18:24307	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014183	MF-414
SSDC–					
6-Rev.1	18:23699	*See* DOE–76-45/6-Rev.1			
STARS–					
8A.	18:23372	*See* PSI–93-01			
STUDSVIK/NS–					
90/93	18:23487	*See* NUREG/IA–0094			
TTKK-JULK–					
87	18:23820	OSTI; NTIS		DE93794776	
TTKK/LT–					
68	18:23821	OSTI; NTIS		DE93794784	
UBA-FB–					
92-104	18:24786	OSTI; NTIS (US Sales Only)		DE93795277	
92-118	18:24835	OSTI; NTIS (US Sales Only)		DE93795328	
UCID–					
21536-Add.2	18:24787	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93008622	MF-902
UCLA-ENG–					
93-19	18:25314	*See* JAERI-M–92-183			
UCLA-FNT–					
54	18:25314	*See* JAERI-M–92-183			
UCRL–					
101096	18:23950	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013840	MF-804; MF-814
UCRL-CR–					
103295-92	18:25179	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013135	MF-704
109416	18:23535	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012314	MF-705
109549	18:25318	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93009322	MF-712
109570	18:23865	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013042	MF-700
109734	18:24286	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014110	MF-700
109772	18:23045	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93009574	MF-702; MF-707; MF-721
110994	18:25002	OSTI; NTIS; GPO Dep.	E 1.99:	DE93009214	MF-706
111711	18:25218	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013185	MF-700
112802-Vol.1	18:23046	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93009575	MF-702
112802-Vol.2	18:23047	OSTI; NTIS; GPO Dep.	E 1.99:	DE93009576	MF-702
113495	18:24177	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012319	MF-706
UCRL-ID–					
106470	18:23156	OSTI; NTIS; GPO Dep.	E 1.99:	DE93011878	MF-705
108067	18:23048	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93009446	MF-702
108158	18:24643	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012383	MF-402
108162	18:23887	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012449	MF-700
108524	18:24788	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013103	MF-706; MF-721
108725	18:23536	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012379	
109792	18:24561	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012392	MF-700
110108	18:24486	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012388	MF-706
110445	18:22904	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93008624	MF-722
110822	18:23675	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93009454	MF-703
111013	18:24789	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93009450	MF-703
111040	18:23891	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93012441	MF-700
111207	18:23892	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93012443	MF-700
111265	18:24499	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012444	MF-700
111403	18:24564	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012445	MF-700
111412	18:23689	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013307	MF-212
111417	18:24912	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93013308	
111487	18:25204	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013309	MF-705
111488	18:24262	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012999	
111532	18:24644	OSTI; NTIS; GPO Dep.	E 1.99:	DE93007413	MF-402
111532-Rev.1	18:24645	OSTI; NTIS; GPO Dep.	E 1.99:	DE93007400	MF-402
111589	18:25319	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013783	MF-706
111598	18:23951	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93011711	MF-721
111749	18:25154	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014374	MF-705
111791	18:23147	OSTI; NTIS; GPO Dep.	E 1.99:	DE93008753	MF-707
111825	18:24853	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93009444	MF-707
111898	18:24500	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013312	MF-706
111963	18:24960	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93009442	
112014	18:24565	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93013101	MF-706

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UCRL-ID–					
112025	18:23896	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93012391	MF-700
112223	18:24463	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013100	MF-706
112298	18:25180	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93011714	MF-712
112336	18:23724	OSTI; NTIS; GPO Dep.	E 1.99:	DE93011715	MF-700
112425	18:24527	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93013785	MF-741
112431	18:24528	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013786	MF-741
112587	18:24464	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013313	MF-706
112719	18:24947	OSTI; NTIS; GPO Dep.	E 1.99:	DE93011718	MF-402
112735	18:24555	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93013935	MF-741
112855	18:25338	OSTI; NTIS; GPO Dep.	E 1.99:	DE93011720	MF-700
113019	18:25003	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013105	MF-706
113500	18:25320	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014368	MF-700
113623	18:24646	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012382	MF-402
113715	18:23979	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013788	MF-700
113718	18:23049	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014367	MF-721
113745	18:22868	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014681	MF-502
113953	18:25434	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013789	MF-400
UCRL-JC–					
105732	18:24051	OSTI; NTIS; GPO Dep.	E 1.99:	DE93011883	MF-712
106122	18:24263	OSTI; NTIS; GPO Dep.	E 1.99:	DE93011957	MF-704
106137	18:23980	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013837	MF-704
106140	18:24178	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013088	MF-700
106541	18:24790	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93010508	MF-702
107113	18:24501	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012570	MF-700
107143	18:24647	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93009283	MF-702
107242	18:25322	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012490	MF-706
107306	18:24465	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012489	MF-706
107601	18:25169	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013347	MF-700
107850	18:24502	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012604	MF-706
107852-Rev.1	18:24961	OSTI; NTIS; GPO Dep.	E 1.99:	DE93011902	MF-700
108020	18:24648	OSTI; NTIS; GPO Dep.	E 1.99:	DE93009296	MF-402
108523	18:24649	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014114	MF-412
108641	18:24650	OSTI; NTIS; GPO Dep.	E 1.99:	DE93009526	MF-707
108750	18:23952	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012480	MF-706
108751	18:24556	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012548	MF-706
108815	18:23050	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93009314	MF-802
108847	18:24651	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012547	MF-702
108866	18:24138	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93009544	MF-721
109229	18:23953	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012496	MF-404
109253	18:25323	OSTI; NTIS; GPO Dep.	E 1.99:	DE93009245	MF-712
109342	18:24473	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012478	MF-706
109348	18:24474	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012487	MF-704
109369	18:25283	OSTI; NTIS; GPO Dep.	E 1.99:	DE93009244	MF-712
109420	18:23830	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012486	
109422	18:23697	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013083	MF-706
109508	18:24791	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012582	MF-721
109590	18:24913	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013353	MF-706
109677	18:22845	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012505	MF-702
109796	18:25324	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012501	MF-706
109804	18:25284	OSTI; NTIS; GPO Dep.	E 1.99:	DE93011874	MF-700
109811-Rev.1	18:25325	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012593	MF-421
109818	18:24487	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013041	MF-706
109822	18:24652	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012583	MF-402
109857	18:24503	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012590	MF-705
109901	18:23051	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012492	MF-721
109948	18:24113	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012476	MF-700
109977	18:25326	OSTI; NTIS; GPO Dep.	E 1.99:	DE93009554	MF-700
110-843	18:25321	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93010500	MF-420
110000	18:25327	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012575	MF-712
110006	18:24973	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012481	MF-705
110015	18:24179	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012499	MF-722
110049-Rev.1	18:24114	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012600	MF-700
110055	18:24792	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93009284	MF-902; MF-903
110069-Rev.1	18:23861	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013089	MF-700
110079	18:23052	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013199	MF-702
110081	18:25004	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014150	MF-703
110102	18:23157	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012485	MF-705
110107	18:23158	OSTI; NTIS; GPO Dep.	E 1.99:	DE93009522	MF-700
110145	18:25198	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012572	MF-706
110193	18:25328	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012578	MF-700

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
110202	18:25329	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013416	MF-712
110204	18:24295	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013415	MF-712
110217	18:25181	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93009256	MF-712
110235	18:24793	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93009249	MF-702
110245	18:24052	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012484	MF-706; MF-704
110271	18:24562	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012494	
110272	18:24563	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012493	MF-706
110274	18:24488	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012482	MF-700
110320-Pt.1	18:22862	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012587	MF-123
110329	18:25330	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014117	MF-712
110334	18:24053	OSTI; NTIS; GPO Dep.	E 1.99:	DE93011886	MF-706
110353	18:24794	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012477	MF-902
110398	18:25331	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93010510	MF-420
110400	18:24653	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93010511	MF-702
110420	18:23676	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93011876	MF-702
110431	18:23842	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012584	MF-721
110525	18:24795	OSTI; NTIS; GPO Dep.	E 1.99:	DE93009291	MF-902
110528	18:24796	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93009252	MF-702
110530	18:24797	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93009239	MF-702
110558	18:24654	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93011950	MF-702
110564	18:25005	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014120	MF-700
110582	18:23508	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93009545	MF-707
110582-Rev.1	18:23148	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93008023	MF-707
110622	18:24798	OSTI; NTIS; GPO Dep.	E 1.99:	DE93007501	MF-702
110826	18:23053	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93007510	MF-721
110827	18:23054	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93009282	MF-902
110844	18:24655	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012550	MF-702
110846	18:24656	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93010501	MF-702
110868	18:25332	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93011947	MF-712
110921	18:23854	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014122	MF-700
110922	18:24657	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93011871	MF-402
110957	18:24799	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93010513	MF-702
110959	18:24800	OSTI; NTIS; GPO Dep.	E 1.99:	DE93009513	MF-702
110974	18:24287	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012580	MF-706; MF-712
110996	18:23954	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013037	MF-704
110999	18:22905	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012488	
111004	18:23955	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013847	MF-904
111025	18:23981	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013131	MF-704
111173	18:25006	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014127	MF-706
111212	18:25435	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012581	MF-705
111218	18:24180	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014421	MF-906
111224	18:25436	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013045	MF-706
111227	18:25437	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012479	MF-705
111229	18:24425	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93011895	MF-706
111233	18:24288	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012577	MF-706
111377	18:23956	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012595	MF-700
111381	18:25333	OSTI; NTIS; GPO Dep.	E 1.99:	DE93011900	MF-700
111382	18:25334	OSTI; NTIS; GPO Dep.	E 1.99:	DE93011901	MF-700
111388	18:24475	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013430	MF-712
111389	18:25335	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93009290	MF-700
111392	18:24289	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012497	MF-712
111396	18:24054	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012596	MF-712; MF-704
111419	18:24854	OSTI; NTIS; GPO Dep.	E 1.99:	DE93011875	MF-408
111437	18:23982	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012579	MF-700
111458	18:23983	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013853	MF-704
111495	18:25007	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013094	MF-706
111555	18:23882	OSTI; NTIS; GPO Dep.	E 1.99:	DE93011884	MF-906
111562	18:24557	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013352	MF-700
111627	18:25219	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013197	MF-700
111712	18:24290	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014115	MF-706
111714	18:24291	OSTI; NTIS; GPO Dep.	E 1.99:	DE93014113	MF-706
111786	18:24801	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93009064	MF-703
111802	18:23182	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013420	MF-700
111831	18:25061	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013350	MF-700
111840	18:25285	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012503	MF-705
111868	18:25170	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013348	MF-700
111883	18:25438	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013047	MF-705
111903	18:25286	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013038	MF-700

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111904	18:25205	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013039	MF-700
111945	18:24292	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013349	MF-705
111956	18:25439	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013044	MF-705
111964	18:23677	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012491	
111969	18:24055	OSTI; NTIS; GPO Dep.	E 1.99:	DE93011894	MF-704
111977-Rev.1	18:24962	OSTI; NTIS; GPO Dep.	E 1.99:	DE93011899	MF-403
111981	18:24963	OSTI; NTIS; GPO Dep.	E 1.99:	DE93011890	MF-403
112015	18:25440	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012576	MF-705
112016	18:25441	OSTI; NTIS; GPO Dep.	E 1.99:	DE93011959	MF-705
112022	18:25442	OSTI; NTIS; GPO Dep.	E 1.99:	DE93011958	MF-700
112052	18:24964	OSTI; NTIS; GPO Dep.	E 1.99:	DE93011952	MF-405
112060	18:23957	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013839	MF-901
112177	18:23693	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013431	MF-700
112215	18:24836	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93011877	MF-702
112275	18:24426	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013831	MF-700
112301	18:25443	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013192	MF-705
112312	18:24056	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012498	MF-700
112342	18:24427	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013851	MF-712
112366	18:24965	OSTI; NTIS; GPO Dep.	E 1.99:	DE93009287	MF-702
112395	18:24802	OSTI; NTIS; GPO Dep.	E 1.99:	DE93009226	MF-721
112397	18:23055	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93009289	MF-721
112518	18:23958	OSTI; NTIS; GPO Dep.	E 1.99:	DE93011881	MF-517
112597	18:25444	OSTI; NTIS; GPO Dep.	E 1.99:	DE93010499	MF-705
112601	18:25445	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012504	MF-705
112602	18:24476	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013048	MF-706
112713	18:25008	OSTI; NTIS; GPO Dep.	E 1.99:	DE93011955	
112806	18:25446	OSTI; NTIS; GPO Dep.	E 1.99:	DE93010519	MF-705
112808	18:25447	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93010520	MF-630
112894	18:24181	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012313	MF-903
113083	18:24182	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93008678	MF-706; MF-702
113199	18:25336	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012318	MF-706
113380	18:24466	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012312	MF-403
113531	18:25448	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013049	MF-705
UCRL-LR–					
105821-92-4	18:25337	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013303	PC-712
107476-Vol.2	18:23056	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014855	PC-802
113247	18:24183	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012438	PC-706
UCRL-MA–					
108965-Rev.1	18:25449	OSTI; NTIS (documentation only); ESTSC (complete software package), P.O. Box 1020, Oak Ridge, TN 37831-1020; GPO Dep.	E 1.99:	DE93013132	MF-705
108975	18:25450	OSTI; NTIS (documentation only); ESTSC (complete software package), P.O. Box 1020, Oak Ridge, TN 37831-1020; GPO Dep.	E 1.99:	DE93013200	MF-705
108976	18:25451	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013091	MF-705
111145	18:25452	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013092	MF-505
112087	18:25453	OSTI; NTIS; GPO Dep.	E 1.99:	DE93013093	MF-705
UFIFT-HEP–					
93-7	18:25023	*See* DOE/ER/40272–182			
UM-P–					
92/102	18:23984	OSTI; NTIS (US Sales Only); INIS		DE93625470	
USGS-OFR–					
92-572	18:23057	OSTI; NTIS; INIS; GPO; U.S. Geological Survey, Books and Open File Reports Section, Federal Center, Box 25425, Denver, CO 80225; GPO Dep.	E 1.99:	DE93013189	MF-814
UTTAC–					
59	18:25382	OSTI; NTIS; INIS		DE93788277	
VTT-TIED–					
1334	18:23795	OSTI; NTIS		DE93794841	
VYH-MON–					
300E	18:23219	OSTI; NTIS		DE93794805	
WAPD-TM–					
1427	18:23959	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012177	MF-520
1623	18:25167	OSTI; NTIS; GPO Dep.	E 1.99:	DE93011390	PC-505
WHC-EP–					
0617-Draft	18:23058	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93011903	MF-902; MF-940
0619-Vol.2	18:23605	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013004	MF-940

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WHC-SA–					
1414	18:22906	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013001	MF-513
1544	18:23059	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93011357	MF-940
1602	18:23463	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014187	MF-532
1682	18:23464	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93011355	MF-513
1690	18:23743	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93011358	MF-902
1698	18:23060	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93011282	MF-940
1723	18:23061	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93011354	MF-905; MF-940
1731	18:23062	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93011252	MF-940
1733	18:23063	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93011280	MF-940
1738	18:23064	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93011278	MF-940
1783	18:25383	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93011279	MF-900
1835	18:23065	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014624	MF-902
1867	18:22907	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93011352	MF-940
1870	18:23159	OSTI; NTIS; GPO Dep.	E 1.99:	DE93011353	MF-900
1883	18:24803	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012619	MF-902
1896	18:24804	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012615	MF-902
1921	18:23066	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013050	MF-902
WHC-SP–					
0909	18:23067	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93011300	MF-940
1689	18:23068	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93011285	MF-940
WINCO–					
1093-Del.Ver.	18:22889	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93014821	MF-510
1110	18:23488	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012545	MF-510
1112	18:23515	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012546	MF-510
1117	18:23489	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012543	MF-510
1118	18:23490	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014823	MF-510
11917	18:23471	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014879	MF-501; MF-506
WRI–					
92-R051	18:22791	*See* DOE/BC/14472–11			
WSRC-IM–					
93-017	18:23744	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013583	MF-702
WSRC-MS–					
91-104-Rev.1	18:23069	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93011774	MF-701; MF-705
91-531	18:23678	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93007449	MF-1031
92-167-Del.Ver.	18:23606	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012845	MF-707
92-224	18:23607	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93009875	MF-706
92-262	18:23679	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93001612	MF-700
92-292	18:23680	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93009858	MF-707
92-362	18:23608	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004879	MF-706
92-365	18:23681	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93009876	MF-706
92-366	18:23682	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93009808	MF-706
92-368	18:23683	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93009809	MF-706
92-369	18:23509	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93011779	MF-706
92-388	18:23609	OSTI; NTIS; GPO Dep.	E 1.99:	DE93006164	MF-706
92-390	18:23610	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93009874	MF-705
92-406	18:23684	OSTI; NTIS; GPO Dep.	E 1.99:	DE93008794	MF-706
92-408	18:24184	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014744	MF-701
92-430	18:23070	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012140	MF-706
92-441	18:23611	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004298	MF-706
92-473	18:24837	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93011773	MF-703
92-479	18:24838	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012139	MF-702
92-505	18:23071	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93011776	MF-701
92-519	18:23612	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012820	MF-705
93-037	18:23960	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93011703	MF-704
93-067	18:24914	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012133	MF-707
93-090	18:23961	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93011782	MF-704
93-135	18:24057	OSTI; NTIS; GPO Dep.	E 1.99:	DE93010376	MF-706
93-143	18:23072	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93010380	MF-700
93-146	18:23149	OSTI; NTIS; GPO Dep.	E 1.99:	DE93012150	MF-705
93-148	18:23185	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93011708	MF-707
93-204	18:23073	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013684	MF-702; MF-721
93-207	18:23074	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013828	MF-721
93-217	18:23075	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012796	MF-700
WSRC-RP–					
89-261	18:23076	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013577	MF-701

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WSRC-RP–					
90-1338-Vol.1-Del.Ver.	18:23685	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93009744	MF-706
90-1338-Vol.2	18:23686	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93009882	MF-706
90-359-Rev.1	18:23077	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012822	MF-721
90-522	18:23078	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93011785	MF-706
92-1099	18:23613	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93014757	MF-706
92-653	18:23687	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013689	MF-701; MF-706
92-910	18:23472	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93013690	MF-707
93-227	18:23079	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93012137	MF-701; MF-721
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